V-VSS Schedule of Events

Scheduled Events

All times displayed St. Pete Beach time: EDT America/New_York

To see this schedule in your timezone, log in to your MyVSS Account and set your timezone.

Date	Time	Event
Friday, June 19	11:00 - 11:40 am	V-VSS Opening Session with VSS Founders Ken Nakayama and Tom Sanocki talk about 20 years of Vision Science
	12:00 - 12:30 pm	Post-Talk Coffee Break Break-out rooms for post-talk interaction
	1:00 - 3:00 pm	Live Talk Session 1
	3:00 - 3:40 pm	Presenter Conferences
	5:00 - 5:40 pm	Presenter Conferences
	6:00 - 6:40 pm	Presenter Conferences
	8:00 - 9:00 pm	Student/Postdoc Board Discusses: Public and Governmental Science Advocacy
	9:00 - 10:00 pm	Student/Postdoc Board Discusses: Social Events
	11:00 - 11:40 pm	Presenter Conferences
Saturday, June 20	1:00 - 1:40 am	Presenter Conferences
	2:00 - 2:40 am	Presenter Conferences
	6:00 - 7:00 am	Student/Postdoc Board Discusses: Diversity -- Under-represented groups
	7:00 - 8:00 am	Advanced vision research paradigms with the PROPixx high refresh rate projector. VPixx Technologies (VSS Satellite)
	8:00 - 8:40 am	Presenter Conferences
	9:00 - 9:40 am	Presenter Conferences
	10:30 - 11:00 am	Pre-Talk Coffee Break Break-out rooms for pre-talk interaction
	11:00 am - 1:00 pm	Live Talk Session 2

	1:00 - 1:30 pm	Post-Talk Coffee Break Break-out rooms for post-talk interaction
	3:00 - 3:40 pm	Presenter Conferences
	4:00 - 5:00 pm	Advanced vision research paradigms with the PROPixx high refresh rate projector. VPixx Technologies (VSS Satellite)
	5:00 - 6:00 pm	Meet the Professors Opportunity for students to meet with faculty members
	6:00 - 6:40 pm	Presenter Conferences
Sunday, June 21	4:00 - 4:40 am	Presenter Conferences
	5:00 - 5:40 am	Presenter Conferences
	7:00 - 8:00 am	High speed eye-tracking in vision science: TRACKPixx3 technology and applications. VPixx Technologies (VSS Satellite)
	8:00 - 9:00 am	Meet the Professors Opportunity for students to meet with faculty members
	9:00 - 9:40 am	Presenter Conferences
	10:30 - 11:00 am	Pre-Talk Coffee Break Break-out rooms for pre-talk interaction
	11:00 am - 1:00 pm	Live Talk Session 3
	1:00 - 3:00 pm	Townhall on Diversity, Inclusion and Respect Join us for this event, co-sponsored with FoVea, for open discussion and exchange of ideas.
	3:00 - 3:40 pm	Presenter Conferences
	4:00 - 5:00 pm	High speed eye-tracking in vision science: TRACKPixx3 technology and applications. VPixx Technologies (VSS Satellite)
	5:00 - 5:40 pm	Presenter Conferences
	6:00 - 6:40 pm	Presenter Conferences

	7:00 - 8:00 pm	An introduction to TELLab: The Experiential Learning Laboratory, an online teaching platform (VSS Satellite)
	8:00 - 9:00 pm	Meet the Professors Opportunity for students to meet with faculty members
	11:00 - 11:40 pm	Presenter Conferences
Monday, June 22	1:00 - 1:40 am	Presenter Conferences
	2:00 - 2:40 am	Presenter Conferences
	3:30 - 4:00 am	Pre-Talk Coffee Break Break-out rooms for pre-talk interaction
	4:00 - 6:00 am	Live Talk Session 4
	6:00 - 6:30 am	Post-Talk Coffee Break Break-out rooms for post-talk interaction
	7:00 - 8:00 am	Timing and synchronization in gaze-contingent displays and other latency-sensitive research paradigms. VPixx Technologies (VSS Satellite)
	8:00 - 8:40 am	Presenter Conferences
	9:00 - 9:40 am	Presenter Conferences
	10:00 - 10:45 am	Business Meeting VSS Board discusses issues of concern to the Society
	11:00 am - 1:00 pm	Live Talk Session 5
	1:00 - 2:00 pm	NIH/NSF Funding Panel Representatives from US funding agencies discuss current funding issues
	3:00 - 4:00 pm	VR Eye Tracking – From zero to experiment in 6 minutes Worldviz VR (VSS Satellite)
	4:00 - 5:00 pm	Timing and synchronization in gaze-contingent displays and other latency-sensitive research paradigms. VPixx Technologies (VSS Satellite)

	5:00 - 6:00 pm	VR Eye Tracking – Meeting in VR to Experience and Discuss Concepts, Setups and Analytics Options Worldviz VR (VSS Satellite)
	6:00 - 6:40 pm	Presenter Conferences
	8:00 - 9:00 pm	Student/Postdoc Board Discusses: Diversity -- Under-represented groups
	9:00 - 10:00 pm	Student/Postdoc Board Discusses: Connections to Industry
	11:00 - 11:40 pm	Presenter Conferences
Tuesday, June 23	1:00 - 2:00 am	Meet the Professors Opportunity for students to meet with faculty members
	2:00 - 2:40 am	Presenter Conferences
	4:00 - 5:00 am	Student/Postdoc Board Discusses: Accessibility at VSS
	5:00 - 6:00 am	Student/Postdoc Board Discusses: Skills workshops
	6:30 - 7:00 am	Pre-Talk Coffee Break Break-out rooms for pre-talk interaction
	7:00 - 9:00 am	Live Talk Session 6
	9:00 - 9:30 am	Post-Talk Coffee Break Break-out rooms for post-talk interaction
	10:30 - 11:00 am	Pre-Talk Coffee Break Break-out rooms for pre-talk interaction
	11:00 am - 1:00 pm	Live Talk Session 7
	1:00 - 1:30 pm	Post-Talk Coffee Break Break-out rooms for pre-talk interaction
	1:30 - 2:00 pm	Visibility: A Virtual Coffee Break for LGBTQ+ Vision Scientists and Friends (VSS Satellite)
	2:00 - 2:40 pm	Presenter Conferences
	3:00 - 3:40 pm	Presenter Conferences

	4:00 - 5:00 pm	Student/Postdoc Board Discusses: Science Communication
	5:00 - 5:40 pm	Presenter Conferences
	6:00 - 6:40 pm	Presenter Conferences
	7:00 - 8:00 pm	Student/Postdoc Board Discusses: Open Science
	8:00 - 9:00 pm	Canadian Vision Social (VSS Satellite)
	11:00 - 11:40 pm	Presenter Conferences
Wednesday, June 24	1:00 - 1:40 am	Presenter Conferences
	2:00 - 2:40 am	Presenter Conferences
	4:00 - 4:40 am	Presenter Conferences
	5:00 - 5:40 am	Presenter Conferences
	7:00 - 8:00 am	Student/Postdoc Board Discusses: VSS outside North America
	8:00 - 9:00 am	Student/Postdoc Board Discusses: Career Development
	10:30 - 11:00 am	Pre-Talk Coffee Break Break-out rooms for pre-talk interaction
	11:00 am - 1:00 pm	Live Talk Session 8
	1:00 - 1:30 pm	Post-Talk Coffee Break Break-out rooms for post-talk interaction
	2:00 - 2:40 pm	Presenter Conferences
	3:00 - 3:40 pm	Presenter Conferences
	4:00 - 4:30 pm	V-VSS Closing Remarks Closing remarks from VSS board members

Live Talk Sessions

Live Talk Session 1

Friday, 19 June, 1:00 pm EDT America/New_York

Talks will be presented in this order:

How do we measure attention? Visual cognition meets neuropsychology

Todd S. Horowitz[1], Melissa Treviño[1], Xiaoshu Zhu[2], Yi Yi Lu[3,4], Grace C. Huang[2], Laura T. Germine[3,4]; [1]Basic Biobehavioral and Psychological Sciences Branch, National Cancer Institute, [2]Westat, [3]Institute for Technology in Psychiatry, McLean Hospital, [4]Department of Psychiatry, Harvard Medical School

The speed of attentional engagement and its relation to working memory encoding in RSVP tasks

Alon Zivony[1], Martin Eimer[1]; [1]Birkbeck, University of London

The Influence of Taxonomic and Thematic Object Relationships on Attentional Allocation

Joseph Nah[1], Joy Geng[2]; [1]University of California, Davis

Space and Time Dissociate in the Construction of the Visual Now

Aditya Upadhyayula[1], Ian Phillips[1], Jonathan Flombaum[1]; [1]Johns Hopkins University

Evidence that a single vergence command does not drive smooth pursuit in depth

Stephen Heinen[1], Scott Watamaniuk[2], Rowan Candy[3], Jeremy Badler[1], Arvind Chandna[1]; [1]Smith-Kettlewell Eye Research Institute, [2]Wright State University, [3]Indiana University

Creating Visual Categories With Closed-Loop Real-Time fMRI Neurofeedback

Marius Cătălin Iordan[1], Victoria J.H. Ritvo[1], Kenneth A. Norman[1], Nicholas B. Turk-Browne[1,2], Jonathan D. Cohen[1]; [1]Princeton University, [2]Yale University

Attentional deployment during visual search predicts subsequent long-term memory of real world objects

Mark E. Lavelle[1], Kobe Cornelison[1], Lauren H. Williams[1], Trafton Drew[1]; [1]University of Utah

True swap errors versus misbinding in visual short-term memory revealed using free full report

Younes Adam Tabi[1], Sanjay George Manohar[1], Masud Husain[1]; [1]University of Oxford

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Live Talk Session 2

Saturday, 20 June, 11:00 am EDT America/New_York

Talks will be presented in this order:

How much time do you have? Introducing a multi-duration saliency model

Camilo Fosco[1], Anelise Newman[1], Patr Sukhum[2], Yun Bin Zhang[2], Aude Oliva[1], Zoya Bylinskii[3]; [1]Massachusetts Institute of Technology, [2]Harvard University, [3]Adobe

Supervised learning enables generalization across dissimilar appearances of the same identity by conceptual rather than perceptual mechanisms

Galit Yovel[1], Maya Gotlieb[1], Naphtali Abudarham[1], Yarden Shir[1]; [1]Tel Aviv University

Intracranial electroencephalography reveals real world vision in humans is a contextually modulated, distributed, and active sensing process

Arish Alreja[1], Vasu Sharma[1], Michael Ward[2], Mark Richardson[3,4], Max G'Sell[1], Louis-Philippe Morency[1], Avniel Ghuman[2]; [1]Carnegie Mellon University, [2]University of Pittsburgh, [3]Harvard University, [4]Massachusetts General Hospital

Exploring the effects of linguistic labels on learned visual representations using convolutional neural networks

Seoyoung Ahn[1], Gregory Zelinsky[1], Gary Lupyan[2]; [1]Stony Brook University, [2]University of Wisconsin-Madison

Which “shoe” is best? Humans know what good training examples look like

Makaela Nartker[1], Michael Lepori[1], Chaz Firestone[1]; [1]Johns Hopkins University

Modeling biases of perceived slant in curved surfaces

Jonathan Tong[1], Robert Allison[1], Laurie Wilcox[1]; [1]York University

The Spatiotemporal Power Spectrum of Natural Human Vision

Vasha DuTell[1], Agostino Gibaldi[1], Giulia Focarelli[1], Bruno Olshausen[1], Marty Banks[1]; [1]UC Berkeley

Perceived and mentally rotated contents are differentially represented in cortical layers of V1

Polina Iamshchinina[1,2], Daniel Kaiser[3], Renat Yakupov[4], Daniel Haenelt[9], Alessandro Sciarra[5,8], Hendrik Mattern[5], Emrah Duezel[4,7], Oliver Speck[4,5,6,7], Nikolaus Weiskopf[9], Radoslaw Martin Cichy[1,2]; [1]Department of Education and Psychology, Freie Universitaet Berlin, Berlin, Germany, [2]Berlin School of Mind and Brain, Humboldt-Universitaet Berlin, Berlin, Germany, [3]Department of Psychology, University of York, Heslington, York, YO10 5DD, UK, [4]German Center for Neurodegenerative Diseases (DZNE), Magdeburg, Germany, [5]Department of Biomedical Magnetic Resonance, Institute for Physics, Otto-von-Guericke-University, Magdeburg, Germany, [6]Leibniz Institute for Neurobiology, Magdeburg, Germany, [7]Center for Behavioral Brain Sciences, Magdeburg, Germany, [8]Department of Neurology, Otto-von-Guericke University, Magdeburg, Germany, [9]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

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Live Talk Session 3

Sunday, 21 June, 11:00 am EDT America/New_York

Talks will be presented in this order:

Amplification of feature selectivity by spatial convolution in primary visual cortex

Felix Bartsch[1], Daniel A. Butts[1], Bruce Cumming[2]; [1]University of Maryland, [2]National Eye Institute

Robust behavioral and neural integration of color and gloss cues for object classification

Maria Olkkonen[1,2], Geoffrey K Aguirre[3], Toni P Saarela[2]; [1]University of Helsinki, [2]Durham University, [3]University of Pennsylvania

Bayesian Image Reconstruction from Retinal Cone Signals

Ling-Qi Zhang[1], Nicolas P. Cottaris[1], David H. Brainard[1]; [1]Department of Psychology, University of Pennsylvania

A unifying framework for understanding neural tuning and representational geometry

Nikolaus Kriegeskorte[1,2], Xue-Xin Wei[1]; [1]Zuckerman Mind Brain Behavior Institute, Columbia University, [2]Department of Psychology, Department of Neuroscience, Columbia University

Decoding 3D spatial location across saccades in human visual cortex

Xiaoli Zhang[1], Christopher M Jones, Julie D Golomb; [1]The Ohio State University

Perception of Nonrigid Change in 3D Shape While Walking in A Virtual Environment

Ying Yu[1], James T Todd[1], Jian Chen[1], Alexander A Petrov[1]; [1]The Ohio State University

Individual Differences in Perceptual Organization: Reanalyzing Thurstone’s classic (1944) data and rediscovering factors for geometrical illusions, perceptual switching, and holistic ‘Gestalt’ closure

David Peterzell[1,2]; [1]John F Kennedy University, [2]University of California, Berkeley

Beyond fixation: foveal receptive field estimation in freely viewing primates

Jacob Yates[1,2,3], Shanna Coop[1,2], Gabriel Sarch[1], Ruei-Jr Wu[1,2], Daniel Butts[3], Michele Rucci[1,2], Jude Mitchell[1,2]; [1]Brain and Cognitive Science, University of Rochester, [2]Center for Visual Science, University of Rochester, [3]Department of Biology, University of Maryland College Park

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Live Talk Session 4

Monday, 22 June, 4:00 am EDT America/New_York

Talks will be presented in this order:

Temporal dynamics of illumination perception: Can we see daylight changes?

Ruben Pastilha[1], Gaurav Gupta[1], Naomi Gross[1], Anya Hurlbert[1]; [1]Newcastle University

Spontaneous brain oscillations and visual perceptual decision making

Jason Samaha[1], Luca Iemi[2], Saskia Haegens[2,3], Niko Busch[4]; [1]University of California, Santa Cruz, [2]Columbia University College of Physicians and Surgeons, [3]Donders Institute for Brain, Cognition and Behaviour, [4]University of Münster

Integrating Single-Unit and Pattern Codes in DCNNs Trained for Face Identification

Connor J. Parde[1], Y. Ivette Colon[1], Matthew Q. Hill[1], Alice J. O'Toole[1], Carlos Castillo[2]; [1]The University of Texas at Dallas, [2]University of Maryland Institute for Advanced Computer Studies

High-attention demand training enhances attentional modulation of V1 and intraparietal sulcus in human adults with amblyopia

Chuan Hou[1], Spero Nicholas[1]; [1]Smith-Kettlewell Eye Research Institute

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Live Talk Session 5

Monday, 22 June, 11:00 am EDT America/New_York

Talks will be presented in this order:

Age-related changes in perceptual decision-making in children

Catherine Manning[1], Udo Boehm[2], Gaia Scerif[1], Anthony M Norcia[3], Eric-Jan Wagenmakers[2]; [1]University of Oxford, [2]University of Amsterdam, [3]Stanford University

Young children outperform feed-forward and recurrent neural networks on challenging object recognition tasks

Vladislav Ayzenberg[1], Stella Lourenco[1]; [1]Emory University

Face selectivity in human infant ventral temporal cortex.

Heather L. Kosakowski[1], MIchael Cohen[1,2], Boris Keil[3], Atsushi Takahashi[1], Isabel Nichoson[4], Lyneé Alves[5], Nancy Kanwisher[1], Rebecca Saxe[1]; [1]MIT, [2]Amherst College, [3]Mittelhessen University of Applied Science, [4]Wellesley College, [5]University of Denver

Visual attention in the first two years of life differentially predicts language abilities in children with and without autism spectrum disorder

Sanju Koirala[1,2], Deniz Parmaksiz[1,2], Stella(Yixin) Yuan[1,2], Sarah Shultz[1,2], Ami Klin[1,2], Warren Jones[1,2], Laura A. Edwards[1,2]; [1]Marcus Autism Center, [2]Emory University

Biological action identification does not require early visual input for development

Siddhart Srivatsav Rajendran[1,2], Davide Bottari[3], Idris Shareef[1,2], Kabilan Pitchaimuthu[1], Suddha Sourav[1], Nikolaus Troje[4], Ramesh Kekunnaya[2], Brigitte Röder[1]; [1]University of Hamburg, Hamburg, Germany, [2]LV Prasad Eye Institute, Hyderbad, India, [3]IMT School for Advanced Studies, Lucca, Italy, [4]Center for Vision Research, York University, Toronto, Canada

Selectivity to limbs in ventral temporal cortex decreases during childhood as selectivity to faces and words increases

Marisa Nordt[1], Jesse Gomez[2,3], Vaidehi S. Natu[1], Alex A. Rezai[1], Dawn Finzi[1], Kalanit Grill-Spector[1,2,4]; [1]Department of Psychology, Stanford University, Stanford, CA, [2]Neurosciences Program, Stanford University, Stanford, CA, [3]Department of Psychology, UC Berkeley, CA, [4]Wu Tsai Neurosciences Institute, Stanford University, Stanford, CA

Deficient functional MRI selectivity and connectivity in developmental prosopagnosia is specific to face regions

Xian Li[12], Joseph Arizpe[12], David Rothlein[13], Mike Esterman[13], Joseph DeGutis[12]; [1]Boston Attention and Learning Laboratory, VA Boston Healthcare System, [2]Harvard Medical School, [3]Boston University School of Medicine

Properties of familiar face representations: No evidence for qualitative differences between personal and media-based familiarity

Holger Wiese[1], Georgina Hobden[1], A. Mike Burton[2], Andrew W. Young[2]; [1]Durham University, [2]University of York

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Live Talk Session 6

Tuesday, 23 June, 7:00 am EDT America/New_York

Talks will be presented in this order:

Spatial cueing effects do not necessarily index spatial shifts of attention

Dominique Lamy[1], Itay Yaron[2], Elinor Hadas[3]; [1]Tel Aviv University

Prior expectations evoke stimulus templates in the deep layers of V1

Fraser Aitken[1], Georgios Menelaou,[2], Oliver Warrington[3], Nadege Corbin[3], Martina Callaghan[3], Peter Kok[4]; [1]University College London

Why are target absent searches so systematic?

Georgin Jacob[1,2], Divya Gulati[2], Pramod RT[1,2], SP Arun[2,1]; [1]Electrical Communication Department, Indian Institue of Science, [2]Centre for Neuroscience, Indian Institute of Science

What is the function of the orientation-tilt illusion?

Thomas Serre[1], Drew Linsley[2], Junkyung Kim[3]; [1]Carney Institute for Brain Science, Department of Cognitive, Linguistic & Psychological Sciences, Brown University

Differential grouping affordances of random spatial and temporal information for accurate number estimation

Frank Durgin[1], Elsie Aubry[1], JJ Balisanyuka-Smith[1], Çiçek Yavuz[2]; [1]Swarthmore College, [2]Haverford College

Analysis and systhesis of natural texture perception by EEG

Taiki Orima[1], Isamu Motoyoshi[1]; [1]Department of Life Sciences, The University of Tokyo

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Live Talk Session 7

Tuesday, 23 June, 11:00 am EDT America/New_York

Talks will be presented in this order:

White matter anatomy and cortical microstructure predict reading-related responses in ventral temporal cortex

Mareike Grotheer[1], Jason Yeatman*[2,3], Kalanit Grill-Spector*[1]; [1]Psychology Department, Stanford University, [2]Graduate School of Education, Stanford University, [3]Division of Developmental and Behavioral Pediatrics, Stanford University, *Authors contributed equally

Causal evidence for parietal lobule dynamics supporting intention readout

Stefano Panzeri[1], Jean-François Patri[1], Atesh Koul[1], Marco Soriano[1,2], Martina Valente[1,3], Alessio Avenanti[4,5], Andrea Cavallo[1,2], Cristina Becchio[1]; [1]Istituto Italiano di Tecnologia, Genoa and Rovereto, Italy, [2]University of Turin, Turin, Italy, [3]University of Trento, Rovereto, Italy, [4]University of Bologna, Cesena, Italy, [5]Universidad Catolica del Maule, Talca, Chile

Neurocomputational Mechanisms of Action-Outcome Prediction in V1

Clare Press[1], Emily Thomas[1], Sam Gilbert[2], Floris de Lange[3], Peter Kok[4], Daniel Yon[1,5]; [1]Birkbeck, University of London, [2]Institute of Cognitive Neuroscience, University College London, [3]Donders Institute for Brain, Cognition and Behaviour, Radboud University, [4]Wellcome Centre for Human Neuroimaging, University College London, [5]Goldsmiths, University of London

Modeling human multitasking behavior in video games through modular reinforcement learning

Sihang Guo[1], Bharath Masetty[1], Ruohan Zhang[1], Dana Ballard[1], Mary Hayhoe[1]; [1]University of Texas Austin

Precise identification of semantic representations in the human brain

Ian Charest[1,2], Emily Allen[3], Yihan Wu[3], Thomas Naselaris[4], Kendrick Kay[3]; [1]School of Psychology, University of Birmingham, UK, [2]Centre for Human Brain Health, University of Birmingham, UK, [3]Center for Magnetic Resonance Research (CMRR), Department of Radiology, University of Minnesota, USA, [4]Neurosciences Department, Medical University of South Carolina, USA

The place memory network: A network of brain areas supporting perception and memory of familiar places.

Adam Steel[1], Madeleine Billings[1], Caroline Robertson[1]; [1]Dartmouth College

Late development of navigationally-relevant motion processing in the occipital place area

Frederik Kamps[1], Jordan Pincus[2], Samaher Radwan[2], Stephanie Wahab[2], Daniel Dilks[2]; [1]Massachusetts Institute of Technology, [2]Emory University

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Live Talk Session 8

Wednesday, 24 June, 11:00 am EDT America/New_York

Talks will be presented in this order:

Multiple salience maps

George Sperling[1], Peng Sun[1], Veronica Chu[1]; [1]University of California, Irvine

Preserved perception of simple visual features in stimulus-based neglect

Seda Akbiyik[1], Teresa Schubert[1], Alfonso Caramazza[1]; [1]Harvard University

Flexible focus in feature-based attention: efficient tuning of attention to narrow and broad ranges of task-relevant feature values

Angus F. Chapman[1], Viola S. Stoermer[1,2]; [1]Department of Psychology, University of California, San Diego, [2]Neurosciences Graduate Program, University of California, San Diego

Both endogenous and exogenous temporal orienting trigger an attentional boost effect

Caitlin A. Sisk[1], Yuhong V. Jiang[1]; [1]University of Minnesota

Intracranial recordings reveal unique shape and timing of responses in human visual cortex during illusory visual events

Maartje Cathelijne de Jong[1,2,3], Mariska J. Vansteensel[4], Raymond van Ee[5,6,7], Frans S. S. Leijten[4], Nick F. Ramsey[4], H. Chris Dijkerman[8], Serge O. Dumoulin[1,3,8], Tomas Knapen[1,3]; [1]Spinoza Centre for Neuroimaging, Amsterdam, The Netherlands, [2]University of Amsterdam, Dept. of Psychology, Amsterdam, the Netherlands, [3]Experimental and Applied Psychology, VU University, Amsterdam, The Netherlands, [4]UMC Utrecht Brain Center, Dept. of Neurology and Neurosurgery, University Medical Center Utrecht, The Netherlands, [5]Philips Research Laboratories, Department of Brain, Behavior and Cognition, Eindhoven, The Netherlands., [6]Experimental Psychology, University of Leuven, Leuven, Belgium., [7]Donders Institute, Radboud University, Department of Biophysics, Nijmegen, The Netherlands., [8]Experimental Psychology, Helmholtz Institute, Utrecht University, Utrecht, the Netherlands.

Attention in rivalrous perception: novel insights from pupillometry

Paola Binda[1], Miriam Acquafredda[1], Claudia Lunghi[2]; [1]University of Pisa, [2]Laboratoire des systemes perceptifs, Departement d etudes cognitives, Ecole normale superieure, PSL University, UMR 8248 CNRS, 75005 Paris, France

Sensitivity vs. awareness curve: a novel model-based analysis to uncover the processes underlying nonconscious perception

Fabian Soto[1], Ali Pournaghdali[1]; [1]Florida International University

Localization and Timing of Cortical Processes Related to the Use of Perceptual Context During Contour Detection: Evidence for Early and Mid-Latency Abnormalities in Schizophrenia

Scott Sponheim[1,2], Seung Suk Kang[3], Victor Pokorny[1], Michael-Paul Schallmo[2], Cheryl Olman[2]; [1]Minneapolis VA Health Care System, [2]University of Minnesota, [3]University of Missouri, Kansas City

Abstracts

3D Perception: Cue combination

A Comparison Between the Use of Afterimages and Physical Stimuli in the Examination of Size Constancy

Poster Presentation - *Topic area: 3D Perception: Cue combination*

Amy Siobhan Millard[1], Irene Sperandio[2], Philippe A. Chouinard[1]; [1]La Trobe University, Australia, [2]University of East Anglia, United Kingdom

Size constancy is the ability to perceive an object as having a fixed size regardless of viewing distance. Laws of geometry provide exact guidelines for how size-distance scaling operates in humans under optimal viewing conditions. Most research on size constancy has used objects that exist in the external environment as stimuli, however, some studies have used afterimages as an alternative. Unlike physical objects, afterimages are a unique subjective experience, so it is unknown if these methodological approaches are comparable. This study (N = 20) examined the size perception of physical objects and afterimages under binocular, monocular, and darkness viewing conditions across ten distances (for a total of 30 trials for each stimulus type). The procedures for the two experiments were designed to be as identical as possible. We calculated the slope of the change in perceived size of the stimuli over viewing distance and then computed how much this slope deviated from the hypothetical slope predicted by a size-distance scaling law known as Emmert's law. ANOVA revealed that the different viewing conditions affected the degree to which size deviated from this law for both afterimages ($F(2,38) = 145.42$, $p < .0001$), and physical stimuli ($F(2,38) = 15.46$, $p < .0001$). Paired-samples t-tests highlighted that size perception of afterimages and physical stimuli differed in the monocular ($p = .02$) and darkness ($p < .0001$) conditions, but not in the binocular ($p = .77$) condition. Our findings show that perceived size closely reflected the size-distance scaling predictions under ideal viewing conditions for both methods. This study provides the first direct comparison of how these two approaches for examining size constancy operate. It is suggested that afterimage research paradigms are comparable to methods that use physical stimuli under ideal viewing conditions and may provide unique benefits to understanding what drives size constancy.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 925

Effects of motion dynamics on classic visual size illusions

Poster Presentation - *Topic area: 3D Perception: Cue combination*

Ryan E.B. Mruczek[1] (rmruczek@holycross.edu), Sean Kelly[1], Abigail Sagona[1], Matthew Fanelli[1], Gideon P. Caplovitz[2]; [1]College of the Holy Cross, [2]University of Nevada, Reno

Perceived size is a function of perceived viewing distance, retinal images size, and various contextual cues such as linear perspective and the size and location of neighboring objects. We have recently shown that adding dynamic components to classic visual illusions can significantly alter the influence of contextual elements, and thus enhance or reduce illusion magnitudes. Interestingly, motion dynamics greatly enhance the effects of the Dynamic Ebbinghaus illusion (size contrast), whereas they reduce the effects of the Dynamic Corridor illusion (size constancy). Here, across three experiments, we explore further differences in the nature of these two dynamic illusions to identify the key dynamic components that enhance or reduce illusion magnitude. In particular, in our previous studies of the Dynamic Corridor illusion, the context itself (i.e., the corridor) was static, whereas for the Dynamic Ebbinghaus illusion, the contextual elements (i.e., the inducers) were dynamic in terms of their size and motion. In Experiment 1, a simplified Dynamic Corridor illusion led to a weak illusion, even when the corridor background was translating. In Experiment 2, a dynamically changing context (i.e., the corridor was only partially visible at any one time) led to a strong illusion. These results were replicated in Experiment 3 using a dynamic version of the classic Ponzo illusion, further limiting potential influences of size contrast from differently sized elements of the corridor background. This pattern of results indicates that a combination of a moving target and a dynamically changing context leads to a particularly strong influence of contextual cues on perceived size.

Acknowledgements: Funding: Dr. and Mrs. Anthony M. Marlon '63 Summer Research Fellowship; Alumni/Parents Summer Research Scholarship Fund

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

Thanks for viewing our poster!
Please note that you can see animated versions of our dynamic stimuli in the accompanying video.
If you have any questions, feel free to contact us: rmruczek@holycross.edu

Abstract ID: 342

Slant perception becomes more biased with less reliable cues, even when stereo cues are available

Poster Presentation - *Topic area: 3D Perception: Cue combination*

Zhongting Chen[1] (ztchen@psy.ecnu.edu.cn), Ping Yang[1], Jeffrey Saunders[2]; [1]East China Normal University, [2]the University of Hong Kong

Perceived 3D slant is often biased, especially when depth information is poor. A possible Bayesian explanation is that visual cues are integrated with a prior that is weighted toward a default (frontal), resulting in biases toward the default when cues are unreliable. By this explanation, slant perception should become less veridical as the cue reliability decreases. In a previous study, we observed that biases in perception of slant from texture varied with slant as expected based on cue reliability. In this study, we varied the reliability of stereo slant information by changing viewing distance (90 vs 180 cm), and measured perceptual biases in perception of slant from stereo and combined stereo and texture. Subjects were presented with images of slanted planar surfaces with surface texture that was either informative (Voronoi) or uninformative (broadband noise), and estimated the perceived surface slant by aligning the palm of their hand. Subjects also performed 2AFC slant discrimination to measure reliability of slant information. A Bayesian model predicts that when stereo information becomes less reliable at longer viewing distance, the amount of perceptual bias would increase and texture information would have more relative influence. In monocular conditions, we found that slant estimates were a nonlinear function of simulated slant, as observed previously, consistent with poorer slant discrimination at low slants. In binocular conditions, discrimination thresholds were larger with longer viewing distance, and slant estimates also showed more bias toward frontal. At near viewing distance, slant estimates varied linearity with slant, and were similar with Voronoi and noise textures. At longer viewing distance, slant estimates were less biased with the informative texture, and showed nonlinearity in the same direction as monocular texture conditions. All of these results are qualitatively consistent with a Bayesian model that integrates slant cues and a prior according to their relative reliability.

Acknowledgements: Supported by the China Postdoctoral Science Foundation (Grant No. 2018M630410)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1004

3D Perception: Models and mechanisms

Active Observers in a 3D World: The 3D Same-Different Task

Poster Presentation - *Topic area: 3D Perception: Models and mechanisms*

Markus D. Solbach[1] (solbach@eecs.yorku.ca), John K. Tsotsos[1]; [1]York University, Department of Electrical Engineering and Computer Science

Most past and present research in computer vision involves passively observed data. Humans, however, are active observers outside the lab; they explore, search, select what and how to look. Here, we are investigating active, visual observation in a 3D world. To focus, we ask subjects to decide if two 3D objects are the same or different, with no constraints on how they view those objects. Such 3D unconstrained, active observation seems under-studied. While many studies explore human performance, usually, they use line drawings portrayed in 2D, and no active observer is involved. The ability to compare two objects seems a core visual capability, one we use many times a day. It would also be essential for any robotic vision system whose role it is to be a real assistant at home, manufacturing or medical setting. To explore the 3D 'same-different task', we designed a novel experimental environment and created a set of twelve 3D printed objects with known complexity. The subject is allowed to move around freely in a 4m x 3m controlled environment, outfitted with eye gaze tracker and observed by head trackers. In this environment, two objects are presented at a time at a fixed 3D locations but with a varying 3D pose. We track precise 6D head motion, gaze and record a video of all actions, synchronized at microsecond resolution. Additionally, the subject is interviewed about how the task was approached. Our results show that at least six strategies for solving this task are employed, not always independently. We found that the strategy used is dependent on three variables: object complexity, object orientation, and initial viewpoint. Furthermore, we show that performance improves over time as subjects refine their strategies throughout the study. Since no external feedback is given, an internal feedback mechanism must exist that refines strategies.

Acknowledgements: We want to thank Khatoll Ghauss for helping to conduct the experiments and Bir Dey Bikram for his help with CAD. This research was supported by grants to John K. Tsotsos from the Air Force Office of Scientific Research USA, the Canada Research Chairs Program, and the NSERC Canadian Robotics Network.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hi!
Thank you for checking out my poster.

Feel free to reach me over email (solbach@eecs.yorku.ca)
If you want to learn more about my work, please visit https://markussolbach.com/
If you want to connect with me on LinkedIn: https://www.linkedin.com/in/markussolbach/

Abstract ID: 253

Comparison of a reinforcement-learning and a biologically-motivated representation of 3D space

Poster Presentation - *Topic area: 3D Perception: Models and mechanisms*

Andrew Glennerster[1] (a.glennerster@reading.ac.uk), Alexander Muryy[1]; [1]University of Reading

Recent advances in reinforcement learning demonstrate that navigation and prediction of novel views do not require the agent to have a 3D model of the scene. Here, we examine a reinforcement learning method that rewards an agent for arriving at a target image but does not generate a 3D 'map'. We compare this to a biologically motivated alternative that also avoids a 3D reconstruction; it is a hand-crafted representation based on relative visual directions (RVD) which has, by design, a high degree of geometric consistency. We tested the ability of both types of representation to support geometric tasks such as interpolating between learned locations. In both cases, interpolation is possible if two stored feature vectors in the network – each associated with a given location - are averaged and the mean vector is decoded to recover a mean location. The performance is much more variable for the reinforcement learning model than for the RVD model (about seven times greater standard deviation). We show the same result for interpolation of camera orientation. A tSNE projection of the stored vectors (into 2D) for each type of representation illustrates why performance of the two models should be different on these tasks. In the RVD model, the tSNE projection shows a regular pattern reflecting the geometric layout of the learned locations in space whereas, for the reinforcement learning model, the clustering of stored vectors reflects other factors such as the agent's goals during training. Our comparison of these two models demonstrates that it is advantageous to include information about the persistence of features as the camera translates (e.g. distant features persist). It is likely that representations of this sort, storing high-dimensional state vectors instead of 3D coordinates, will be increasingly important in the search for robust models of human spatial perception and navigation.

Acknowledgements: Funded by EPSRC/Dstl EP/N019423/1

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

I am very happy to chat and answer questions. If I am not monitoring the chat, try me on a.glennerster@reading.ac.uk. The paper has now been accepted in Vision Research and is available on arXiv: https://arxiv.org/abs/1912.06615 . Thanks! Andrew

Abstract ID: 384

Neural representation of illusory reversed depth in anti-correlated random-dot stereograms across visual cortical areas in central and peripheral visual fields: An fMRI study

Poster Presentation - *Topic area: 3D Perception: Models and mechanisms*

Li Zhaoping[1,2] (li.zhaoping@tuebingen.mpg.de), Pablo Grassi[1], Jinyou Zou[2], Michael Erb[1], Klaus Scheffler[1,2], Andreas Bartels[1]; [1]University of Tuebingen,, [2]Max Planck Institute for Biological Cybernetics

In a random-dot stereogram (RDS), depth percepts of object surfaces are generated using left-eye and right-eye images that comprise interocularly corresponding random black and white dots. The spatial disparities between the corresponding dots determine the surface depths. If the dots are anti-correlated, such that a black dot in one monocular image corresponds to a white dot in the other, disparity tuned neurons in the primary visual cortex (V1) respond as if their preferred disparities become non-preferred and vice versa, reversing the disparity signs reported to higher visual areas. Humans can perceive this illusory reversed depth in peripheral but not central visual field (Zhaoping & Ackerman 2018), confirming a prediction (Zhaoping 2017) that feedback from higher visual areas to V1, for analysis-by-synthesis in recognition to veto the reversed depth signals from V1 for violating internal knowledges about the visual world, is weaker peripherally. The current study obtained fMRI responses to the RDSs across the visual hierarchy. A linear decoder is trained to recognize the depth order of a disk against background in correlated RDSs using fMRI activity patterns of a brain region in response to such RDSs. If the decoding performance is better than chance after training, we apply the decoder to the fMRI activity patterns in response to the anti-correlated RDSs to see whether it better reports the reversed than non-reversed depth, and if so, then the brain region is said to signal reversed depth. Reversed depth signals were more likely found in higher (e.g., parietal) than lower (e.g., V1, V2) visual areas, more likely for peripherally viewed RDSs, and more likely for observers who perceived reversed depth (peripherally). Some brain areas,

e.g., hV4 and LO, contain the reversed depth signals in central view even though observers could not perceive them, particularly among observers who can perceive reversed depth peripherally.

Acknowledgements: Funded by the Max Planck Society and the University of Tuebingen

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 5:00 am EDT America/New_York

Presenter's Message

Hi, please email me at li.zhaoping@tuebingen.mpg.de if you like me to hear details of my poster, and then we can schedule some video conferences, sorry that I did not realize I have to schedule with VSS by June 12th, but I can easily schedule separate meetings with you now that I have passed the deadline.
thank you very much for your interests.
Li Zhaoping

Abstract ID: 1522

Orthogonal multi-view three-dimensional object representations in memory revealed by serial reproduction

Poster Presentation - *Topic area: 3D Perception: Models and mechanisms*

Thomas Langlois[1] (thomas.langlois@berkeley.edu), Nori Jacoby[2], Jordan Suchow[3], Thomas Griffiths[1];
[1]Princeton University, [2]Max Planck Institute for Empirical Aesthetics, [3]Stevens Institute of Technology

The internal representations of three dimensional objects within visual memory are only partially understood. Previous research suggests that 3D object perception is viewpoint dependent, and that the visual system stores viewpoint perspectives in a biased manner. The aim of this project was to obtain detailed estimates of the distributions of 3D object views in shared human memory. We devised a novel experimental paradigm based on crowdsourcing and transmission chains to investigate memory biases for the 3D orientation of objects. In the transmission chains, a subject's reconstruction of the remembered view of an object becomes the stimulus for the next subject (a process analogous to the 'telephone game'). Using a specialized crowdsourcing platform, we generated large-scale transmission chains over amazon mechanical turk (amt) probing the remembered 3D view for a set of common 3D objects and shapes. We found that memory tends to be biased towards orthogonal diagrammatic perspectives of these objects, and that these biases are strongest for side views as well as top or bottom views for a small set of bilaterally symmetric objects. Finally, we found that views sampled from the modes were easier to categorize in a recognition task. Our approach reveals nuanced structure in shared memory biases that has

eluded previous experimental approaches. Our croudsourcing platform also provides a general framework for curating different network structures over amt in which group estimates rather than individual responses can be transmitted through a chain.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 289

Perception of the Similarity Structure of Objects: A Stratified Model

Poster Presentation - *Topic area: 3D Perception: Models and mechanisms*

Geoffrey Bingham[1] (gbingham@indiana.edu), Xiaoye Wang[1,2], Mats Lind[3]; [1]Indiana University, Bloomington, IN USA, [2]York University, Toronto, ON Canada, [3]Uppsala University, Uppsala, Sweden

Inaccurate judgment of metric 3D shape has been found in SFM studies and modeled as perceived relief structure (ambiguous depth scaling). However, large perspective changes (≤45°) were found to yield accurate judgments of width-to-depth aspect ratios (Lind & Bingham, 2008) and of slant (but only with non-coplanar points = bumpy surfaces) (Wang et al, 2018, 2019a, who replicated results with SFM, pure stereomotion, or both combined). Wang et al (2019b) simulated slant judgments using a stratified model that produced (1) 3D relief structure from two frame optic flow, (2) 3D similarity structure from relief structure under large perspective change, and (3) estimates of slant or aspect ratio. Polyhedrons yield non-coplanar points under planar surfaces. We now displayed polyhedrons to test judgments of both slant and aspect ratio. We tested rectangular, hexagonal, or asymmetric pentagonal objects in SFM and stereo displays with rotations of 25° to 65° with 10° increments. Using red-cyan random texture anaglyphs, objects were presented 9 cm in front of a random texture background that was 18 cm behind the screen and viewed from 76 cm in front of the screen. Each rotation (e.g. 25°) was half to one side (12.5°) and then to the other side (12.5°). In Experiment 1, aspect ratios varied from 0.8 to 1.2 and top surface slants varied from 27° to 73° by 2° increments. In Experiment 2, aspect ratios were varied from 0.4 to 1.2 by 0.04 increments with horizontal tops. Ten participants for each shape in each experiment (60 total) judged slant in Experiment 1 by adjusting the orientation of a response line and aspect ratio in Experiment 2 by adjusting an object shaped outline. Accuracy was poor until rotations of 35° or 45° where both judgments types became and remained accurate for larger rotations as predicted by the stratified model.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 527

Pooling model of tilt estimation based on surface tilt statistics in natural scenes

Poster Presentation - *Topic area: 3D Perception: Models and mechanisms*

Seha Kim[1] (sehakim@upenn.edu), Johannes Burge[1]; [1]University of Pennsylvania

Visual systems estimates three-dimensional (3D) structure of the environment from two-dimensional (2D) retinal images. To improve accuracy, visual systems use multiple sources of information. Here, we examine how human visual systems use prior information about the world to improve the estimation of 3D surface tilt. We analyzed the statistics of 3D tilts in natural scenes from a large stereo-image database with co-registered distance information at each pixel. We found a systematic pattern governing how tilts are spatially related in natural scenes. We designed a hierarchical model that pools local tilt estimates in accordance with these scene statistics. The model first computes a Bayes-optimal local estimate given three image cues (i.e. luminance, texture, and disparity). The model then computes a “global” estimate by pooling the local estimates within a neighborhood centered on the target location. The orientation and aspect ratio of each pooling neighborhood was dictated by the natural scene statistics. The model was evaluated how accurately it estimated groundtruth tilt in natural scenes and how accurately it predicted human performance. Human performance was determined in a psychophysical experiment. Humans viewed natural scenes through a stereoscopically defined circular aperture that was 3deg in diameter. The task was to estimate the surface tilt at the center of the patch via a mouse-controlled probe. Four human observers participated in two experiments; each experiment contained 3600 unique stimuli. We found that the global model provides more accurate estimates of groundtruth tilt and better predictions of human performance than the local model. We also found that the pooling neighborhood areas that maximized estimation accuracy were very similar to the pooling neighborhood areas that best predict human performance. Taken together, the results suggest that human visual systems integrate local estimates in accordance with statistics of surface tilt natural scenes.

Acknowledgements: This work was supported by NIH grant R01-EY028571 from the National Eye Institute & Office of Behavioral and Social Science Research and NIH grant R01-EY011747 from the National Eye Institute.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1239

3D Perception: Shape and space

Aging and Outdoor Visual Distance Perception

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Jessica Dukes[1] (jessica.dukes879@topper.wku.edu), J. Farley Norman[1], Hannah Shapiro[1], Ashley Peterson[1]; [1]Western Kentucky University

Prior studies have consistently found that human observers exhibit visual compression, such that distances in depth (along an observer's line of sight) appear shorter than they really are (Loomis, Da Silva, Fujita, & Fukusima, 1992; Norman, Crabtree, Clayton, & Norman, 2005; Norman, Todd, Perotti, & Tittle, 1996; Wagner, 1985). In contrast, Bian and Andersen (2013) found that older adults (but not younger adults) could estimate egocentric distances (up to 12 meters) accurately. The purpose of the current study was to investigate whether this superiority of performance for older adults extends to distances greater than 12 meters. The current experiment used Gilinsky's method (1951) of creating equal-appearing intervals in depth. On any given trial, participants first viewed an orange traffic cone placed at an egocentric distance of 6m. They were then required to place five additional traffic cones (one by one) along their line of sight so that each subsequent cone appeared to be an additional 6m farther away (for accurate performance, the last cone should be placed 36m away from the participant). Twenty-one younger and older adults participated in the current study. An analysis of the results revealed a significant effect of increasing distance upon error magnitude [$F(4,68) = 40.5$, $p < 0.000001$], but there was no significant main effect of age [$F(1,17) = 0.01$, $p = 0.91$]. The current results therefore suggest that the previously obtained superiority in performance for older adults may not necessarily extend to large environmental distances.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for viewing my abstract and poster presentation. If you are interested in asking me any questions, feel free to send me an email at (jessica.dukes879@topper.wku.edu). I am looking forward to corresponding with you all!

Abstract ID: 136

Familiar size affects size and distance perception for real objects, even in the presence of oculomotor cues.

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Margaret Maltz[1,2] (mmaltsev@uwo.ca), Jody Culham[1,2]; [1]Department of Psychology, University of Western Ontario, [2]Brain and Mind Institute, University of Western Ontario

In the real world, do we rely on our knowledge of object size (i.e., familiar size) for space perception or do we compute object dimensions from a combination of the retinal image and oculomotor cues? Under restricted viewing conditions (i.e., a monocular pinhole to minimize oculomotor cues), when an object's retinal angle is the only cue to size and distance, the visual system relies on familiar size. In this case, when presented with objects, for which the actual size is inconsistent with the familiar size (e.g., unusually large chairs), perception is inaccurate (e.g., Ittelson, 1951). In contrast, under unrestricted binocular viewing in natural environments, familiar size may have little or no effect on perceived size (e.g., Predebon, Wenderoth, & Curthoys, 1974). We examined size and distance perception while manipulating not just the physical size and distance of objects from the viewer, but also the congruency of objects with their familiar sizes and the availability of oculomotor cues. We presented real Rubik's cubes and dice, each either in a size congruent with expectations (5.7-cm Rubik's cube and 1.6-cm die) or the reverse or incongruent size (5.7-cm die and 1.6-cm Rubik's cube), at two distances (25 cm and 91 cm). Participants viewed one object at a time in a dark tunnel (to eliminate pictorial cues), either monocularly through a 1-mm pinhole (to eliminate oculomotor cues) or binocularly (with full oculomotor cues). Participants indicated the perceived size and distance of an object by moving their fingers apart (manual estimation). Regardless of the presence or absence of oculomotor cues, familiar size affected both size and distance perception: Rubik's cubes were perceived as larger and farther than dice, even when objects had identical dimensions. In sum, familiar size is a potent visual cue that affects object perception even during binocular viewing.

Acknowledgements: Natural Sciences and Engineering Research Council (NSERC) Discovery Grant; NSERC Create Grant.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Since first-author Margaret Maltz is unable to give the presentation (and it was recorded by her advisor, Jody Culham, with permission from VSS and from Margaret), we will not be hosting any presenter conferences. Questions can be directed through chat and either Margaret or Jody will reply.

You can also email questions to jculham at uwo dot ca, especially as I don't think chat notifies people when a reply is posted.

We didn't have time to do closed captioning, but anyone who wants to see the talk notes can email Jody to request a version of the PowerPoint slides that includes notes with talking points for each slide.

For more information about our lab, see www.culhamlab.com

Abstract ID: 1568

Linking language descriptions and social trait perception of three-dimensional body shapes

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Ying Hu[1] (yxh144230@utdallas.edu), Victoria Huang[1], Matthew Q. Hill[1], Alice J. O'Toole[1]; [1]The University of Texas at Dallas, USA

Three-dimensional body shapes can be reconstructed using physical attribute descriptions (e.g., skinny, wide shoulders; Hill et al., 2016; Streuber et al., 2016). Body shapes can also predict diverse social trait judgments (e.g., extraverted, lazy; Hu et al., 2018). Here we explored the relationships between body shapes, physical descriptions, and social judgments, bridging the gap between Hill et al. (2016) and Hu et al. (2018). Bodies (N=140; 70 female, 70 male; Hu et al., 2018) were synthesized using normally distributed random values on 10 coefficients in a PCA space from the Skinned Multi-Person Linear Model (Loper et al., 2015), a model derived from laser scans of over 1700 people. Each body was rated (N=38 raters) using 30 physical attribute descriptions. First, we predicted these descriptions from body shape coefficients using multiple linear regression. Body shapes predicted physical descriptions (average cosine similarity between predicted and rated physical descriptions was 0.78 for female and 0.75 for male bodies) more accurately than body shapes predicted social judgments (0.36 for female and 0.39 for male bodies, Hu et al., 2018). Second, we explored the correlations between physical descriptions and trait judgments. Social judgments that indicated high extraversion, conscientiousness, openness, and low neuroticism were positively correlated with skinny, fit and attractive. These judgments were negatively correlated with heavy, round apple, curvy, and broad shoulders. Third, we predicted social trait judgments from physical attribute descriptions. The best-predicted traits were from the extraversion and conscientiousness domains. Physical attribute descriptions predicted trait judgments (average cosine similarity between predicted and rated trait judgments was 0.48 for female and 0.42 for male bodies) more accurately than body shapes predicted

trait judgments (0.36 for female, 0.39 for male bodies, Hu et al., 2018). This study provides insights useful for integrating 3D body modeling, verbal descriptions, and social perception of bodies.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 581

No Vergence Size Constancy

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Paul Linton[1] (paul.linton.vision@gmail.com); [1]Centre for Applied Vision Research, City, University of London

Vergence size constancy is thought to be entirely (Taylor, 1941; Mon-Williams, Tresilian, Plooy, Wann, & Broerse, 1997) or largely (Sperandio, Kaderali, Chouinard, Frey, & Goodale, 2013) responsible for the Taylor illusion. Observers report that an after-image of their hand appears to grow or shrink if they move their hand back-and-forth in complete darkness whilst tracking their hand with their gaze. However, given observers known their hand position, this phenomenon could equally reflect cognitive biases in size estimation. In order to isolate vergence size constancy we asked subjects to view a target whose vergence changed from 50cm to 25cm over 5 seconds (same rate of change as the observer's hand in Sperandio et al., 2013) and judge whether the target increased or decreased in size? During each trial the physical size of the target also increased or decreased by a variable amount, and we tested whether the change in vergence biased the observers' size judgements. We tested 11 observers, and estimated the population bias using a hierarchical Bayesian model. Our results suggest that vergence had no effect on size judgements. The bias we observed (-0.2% of angular size) was (1) in the wrong direction for size constancy, (2) not statistically significant, (3) four times more likely under the null hypothesis (no effect of vergence on perceived size) according to the estimated Bayes factor, with (4) any true size constancy effect being smaller than the smallest effect size of interest (using detection threshold of the most sensitive observer as criterion for inferiority test). Chen, Sperandio, Henry, & Goodale (2019) suggest that real-world size-constancy could either be attributed to (1) recurrent processing in V1, or (2) feedback from higher-order visual areas to V1. Our results suggest that recurrent processing of the vergence signal in V1 is not responsible for real-world size-constancy.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Poster PDF: https://osf.io/tb3un/
Poster Video: https://youtu.be/VhpYjPj5Q80
Preprint: https://www.biorxiv.org/content/10.1101/2020.02.23.961649v1

Please send me your comments in the VSS Chat or via Twitter:
https://twitter.com/LintonVision/status/1273907590943199234

Looking forward to hearing your thoughts!

Abstract ID: 1048

Stereopsis Aids Perceived Distance Based on An Exocentric Pointing Task

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Xiaoye Michael Wang[1] (xywang01@yorku.ca), Adam O. Bebko[1], Anne Thaler[1], Nikolaus F. Troje[1]; [1]York University

e human visual system seems to be well able to interpret the layout of objects in pictures but is less accurate in determining the location from which the picture was taken. Here, we used an exocentric pointing task in immersive virtual reality (VR) to infer the perceived distance between the observer and a pointing virtual character (VC). Participants adjusted orientations of the VC to a highlighted target positioned on a 2.5m-radius circle. We presented the VC inside a frontoparallel frame at the center of this circle. The frame either behaved like a picture or like a window. We also used two intermediate conditions: either stereopsis behaved as if the frame was a window and motion parallax behaved as if it was a picture, or vice versa. The VC was rendered at different distances relative to the frame (-2, -1, 0, and 1m) as determined by projected size and perspective projection, as well as stereopsis and motion parallax information, depending on condition. Perceived distance was inferred from the adjusted pointing direction and the known location of the target. Perceived distance deviated systematically from the intended distance. The data could be modeled accurately (r^2 mean = 0.93, SD = 0.08) after taking a second parameter into account – a depth compression factor. We found that if the frame did not provide stereopsis perceived distance varied little as a function of intended distance and was estimated to be closely behind the frame, and there was little depth compression. However, when the frame provided stereopsis perceived distance was close to the intended distance when taking considerable depth compression into account. This study demonstrated that when viewing a picture, observers perceive

depicted objects to be slightly behind the picture plane even if size, perspective, and motion parallax indicate different distances, and stereopsis dominates perceived distance.

Acknowledgements: This study is supported by the VISTA Postdoc Fellowship to XMW.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1171

The impact of monocular self-occlusions on depth perception

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Domenic Au[1] (domau@my.yorku.ca), Laurie Wilcox[2]; [1]York University

Although the position in depth of monocularly occluded regions (half-occlusions) is ambiguous, there is considerable evidence that the visual system capitalizes on this information to enhance the speed and accuracy of binocular depth perception (Gillam & Borsting, 1988). To date, depth percepts from half-occlusions has been studied almost exclusively in configurations where a surface occludes part of the background in one eye. However, monocular regions also result from self-occlusion and in such cases, because the monocular region forms part of the foreground object, they could influence its perceived shape. Here we evaluated how monocularly occluded regions resulting from self-occlusion influence the perception of depth in 3D volumetric objects. Stimuli were greyscale textured truncated half-ellipses rendered stereoscopically using Blender and viewed in a mirror stereoscope. In a series of experiments, we manipulated the degree to which half-occluded regions were consistent with 3D viewing geometry. We also assessed perceived object coherence using a method of constants (yes/no), and perceived depth magnitude for these objects under geometrically valid and invalid viewing conditions. Our results show that there is surprising tolerance to invalid occlusion arrangements when monocular regions are perceived as part of an occluding object. Furthermore, unlike conventional surface/background half-occlusions, we find that quantitative depth percepts from self-occlusions do not follow model predictions based on binocular viewing geometry even when the occluded region is consistent with viewing geometry. Taken together our experiments show that the interpretation half-occlusions depends critically on their context; heuristics used to extract depth information from such monocular regions are contingent on foreground/background segmentation.

Acknowledgements: This project was supported by VISTA (Vision: Science to Applications)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1146

The perception of parallelism and the perceived orientation of 'parallel' objects

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Eric Hiris[1] (ehiris@uwlax.edu), Henry Rickman[1], Laura Zinnel[1], Joshua Phillips[1]; [1]University of Wisconsin - La Crosse

The leaning tower illusion and similar illusions illustrate that the orientation of objects in three-dimensional space is affected when viewing multiple pictures. We directly measured the accuracy of perception when viewing multiple pictures in order to better understand this effect. Across several experiments, 10-20 participants viewed two pictures for 3 seconds. One picture was a sidewalk receding into the distance to the left, right, or straight ahead. The second picture was either another sidewalk, a non-sidewalk nature scene, or nothing. After the stimuli disappeared, participants adjusted the orientation of an on-screen line to match the orientation of a sidewalk. After completing this task, participants viewed all possible combinations of sidewalk pictures twice, judging how parallel the sidewalks appeared to be on a 1 to 5 scale. When judging sidewalk orientation, perception was most affected when the two sidewalks presented were perceived as being parallel to each other. In these cases, the sidewalks were judged to have orientations more similar to each other than when each was paired with a nature scene or nothing. The maximum degree of misperception was approximately twice as large as the misperception in the leaning tower illusion. Additional experiments show that this effect fully survives inversion and partially survives alternating presentation of the two pictures. However, cueing the participants during the stimulus presentation about which of the two sidewalks will be judged eliminated the effect. We conclude that when viewing multiple pictures containing objects with perspective convergence, those objects' orientations are misperceived, particularly objects that are perceived as parallel or nearly parallel. This misperception occurs over a wide range of conditions, but is eliminated when attention can be focused on only one of the pictures. These data suggest that the perception of elements in a picture are adjusted based on visual integration across pictures.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for your interest in our research The video is only meant to guide you through the main procedures and findings - the poster itself has all the details. Feel free to contact Eric Hiris at ehiris@uwlax.edu at any time if you have questions about this research.

Abstract ID: 898

Understanding the cause of perceptual depth-sign ambiguity with dihedral angles created with motion parallax

Poster Presentation - *Topic area: 3D Perception: Shape and space*

Mark Nawrot[1] (mark.nawrot@ndsu.edu), Emily Johnson[1], Mark Delisi[1]; [1]North Dakota State University

Early research employing computer-generated dihedrals suggested that depth from motion parallax (MP) is unstable and depth-sign ambiguous. The pursuit theory of motion parallax suggests that perceptual instability and depth-sign reversals are the result of stimulus parameters exceeding the physically-possible conditions for a rigid stimulus as described by the Motion/Pursuit Law. When the Motion/Pursuit Ratio approaches 1, depth from MP approaches infinity. The visual system may recognize when stimulus retinal image velocity exceeds pursuit velocity (M/PR > 1,) representing an impossible rigid object. Such conditions are easily generated with computer-generated MP stimuli, producing depth-sign reversals and perhaps concomitant changes to perceived depth magnitude. To test this, we are measured perceived depth magnitude, in addition to depth-sign, with dihedral stimuli. Psychophysical stimuli included both physical and virtual dihedrals having two planes intersecting with a vertex on the horizontal meridian, facing or opposing the observer. With the 40 cm viewing distance, both stimulus types subtended 10.6 degrees. The virtual random-dot MP stimuli used M/PR gradients to depict the two slanted planes with varying relative depth magnitudes (60-110 mm) and therefore varying slants (19-30 degrees). Physical stimuli were 3D printed with varying slants (15-75 degrees). Observers indicated both slant of the front-facing plane using orientation of their palm, and perceived depth-sign of the vertex. With full-cue viewing of physical stimuli, observers underestimated slant by half (individuals varied between 0.3-0.7). Because an underestimate of slant signals an increase in perceived depth, the reported slants of MP stimuli were corrected with functions derived from the physical stimuli. Subsequently with MP stimuli, observers overestimated slopes indicating, similar to previous work, remarkable underestimation of perceived depth magnitude. In addition, increasing MP stimulus parameters to represent depth magnitudes that are impossible within the framework of the Motion/Pursuit Law produces both depth-sign reversals and reductions in perceived depth magnitude.

Acknowledgements: Supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under grant number 5P30GM114748.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Please let me know if you'd like to Zoom at some other time (mark.nawrot@ndsu.edu)

Abstract ID: 1440

3D Perception: Virtual environments

Experimental design with Unity Game Engine

Poster Presentation - *Topic area: 3D Perception: Virtual environments*

Adam O. Bebko[1] (adambebko@gmail.com), Nikolaus F. Troje[1]; [1]York University, Toronto

Advances in virtual reality (VR) technology have provided a wealth of valuable new approaches to vision researchers. VR offers a critical new depth cue, active motion parallax, that provides the observer with a location in the virtual scene that behaves like true locations do: It changes in predictable ways as the observer moves. The contingency between observer motion and visual stimulation is critical and technically challenging and makes coding VR experiments from scratch impractical. Therefore, researchers typically use software such as Unity game engine to create and edit virtual scenes. However, Unity lacks built-in tools for controlling experiments, and existing third-party add-ins require substantial scripting and coding knowledge to design even the simplest of experiments, especially for multifactorial designs. Here, we describe a new free and open-source tool called the BiomotionLab Toolkit for Unity Experiments (bmlTUX). Unlike existing tools, our toolkit provides a graphical interface for configuring factorial experimental designs and turning them into executable experiments. New experiments work “out-of-the-box” and can be created with fewer than twenty lines of code. The toolkit can automatically handle the combinatorics of both random and counterbalanced factors, mixed designs with within- and between-subject factors, and blocking, repetition, and randomization of trial order. A well-defined API makes it easy for users to interface their custom-developed stimulus generation with the toolkit. Experiments can store multiple configurations that can be swapped with a drag-and-drop interface. During runtime, the experimenter can interactively control the flow of trials and monitor the progression of the experiment. Despite its simplicity, bmlTUX remains highly flexible and customizable, catering to both novice and advanced coders. The toolkit

simplifies the process of getting experiments up and running quickly without the hassle of complicated scripting.

Acknowledgements: NSERC Discovery Grant to NFT and contributions from the CFREF Vision: Science to Application

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Presenter conferences will be workshop-style.
- I will help you set up a project using bmlTUX and we can design a simple experiment together.
- Please have Unity 2019.3 installed and running on your system, and join the meeting at the scheduled time.
- Access to VR system is not necessary for this introductory session.

Abstract ID: 810

From reaching to walking: How we build robust spatial representations for visually guided actions

Poster Presentation - *Topic area: 3D Perception: Virtual environments*

Harun Karimpur[1,2] (harun.karimpur@psychol.uni-giessen.de), Johannes Kurz[3], Katja Fiehler[1,2];
[1]Experimental Psychology, Justus Liebig University Giessen, [2]Center for Mind, Brain and Behavior (CMBB), University of Marburg and Justus Liebig University Giessen, [3]NemoLab - Neuromotor Behavior Laboratory, Justus Liebig University Giessen

When reaching for an object, we make use of spatial representations that our brain constantly builds in a fraction of a second. Decades of research established that we encode action targets not only relative to ourselves, egocentrically, but also relative to other objects in the scene, allocentrically. The vast majority of experiments relied on static scenes. In these scenes, participants had to memorize the location of objects before they were asked to reach or point to a cued object location from their memory. Little is known whether these findings can be generalized to larger dynamic environments. To test this, we created virtual reality experiments in which participants were faced with a throw-in situation, like in soccer. The task was to memorize the landing position of a ball that was thrown by an avatar. The ball was thrown either closer to the avatar or closer to the participant. After the ball had landed, we removed elements of the scene that could be used as landmarks (i.e., the avatar and the midfield line) before they reappeared for a short time,

either laterally shifted or not. Participants were then prompted to take a real ball, walk to the memorized landing position and place it there. A use of landmarks should be reflected in a systematic bias of the reproduced ball landing position in direction of the landmark shift. We found that this was the case, similar to previous findings in classic reaching and pointing experiments. Moreover, we found differences in the weighting between both landmarks depending on whether the ball landed closer to the avatar or to the participant. Our findings suggest that our brain builds robust spatial representations that can be used for different sized environments, different response modes and for static as well as dynamic target objects.

Acknowledgements: International Research Training Group (IRTG) 1901 “The brain in action” funded by the German Research Foundation (DFG) and the DFG FI 1567/6-1 TAO “The active observer” awarded to KF. A dissertation fellowship of the German Academic Scholarship Foundation/Studienst. d. dt. Volkes was awarded to HK

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

Thanks for stopping by! Please feel free to contact me anytime via email
harun.karimpur [at] psychol.uni-giessen [dot] de
I am happy to schedule individual Zoom calls!

Abstract ID: 359

Integrating visual-vestibular mismatch and posture instability in Virtual Reality: A cyber-sickness study

Poster Presentation - *Topic area: 3D Perception: Virtual environments*

Adrian K. T. Ng[1] (adriang@hku.hk), Leith K. Y. Chan[1], Henry Y. K. Lau[1]; [1]The University of Hong Kong

Virtual reality (VR) displays can introduce nausegenic symptoms, often known as cyber-sickness. One dominant hypothesis explained the malady by the mismatch between afferent signals from visual, vestibular, and other systems, and the discrepancy with the predictions made based on real-world experiences. Another proposed that sickness occurs when one’s ability to maintain a stable bodily orientation is challenged. To date, only a few studies have been conducted to examine the interactions between them. Here, we explore the effects of visual-vestibular mismatch and posture instability through measuring cyber-sickness discomfort level and symptoms. The independent variables involving two levels of: sensory conflict (with or without illusory self-motion elicited visually by an HTC Vive head-mounted

display) and postural challenge (with or without low-frequency vibration induced while a participant stands on a 3DoF motion platform), were manipulated alone or in combination. Together with the control condition, participants (n = 12) experienced one of the four conditions for 4.4 min each day in four separate days. During the stimulus presentation, the participant engaged in a visual search task that promote similar eye movement across conditions while the discomfort was measured using Misery Scale (MISC) every minute and Simulator Sickness Questionnaire (SSQ) before and after each condition. Results showed that higher discomfort levels and more symptoms were associated with the combined and the sensory conflict only condition compared to other conditions. In addition, spontaneous postural instability was measured while the participant stood on a Wii balance board for 1 min with their eyes closed. The standard deviation of the center of pressure (CoP) displacement in the anterior-posterior (AP) direction was higher after experiencing the combined condition than before the exposure. Our results suggest that the visual-vestibular mismatch might be one of the requisite causes for cyber-sickness, while postural stability might be a moderator variable.

Acknowledgements: AKTN was supported by HK PhD Fellowship Scheme from the Research Grant Council of Hong Kong.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

The first author Adrian K. T. Ng can always be reached at adriang@connect.hku.hk
He welcomes any chats including vision science and virtual reality.
He is looking for Post-doc position starting on Sept 2021.

Abstract ID: 205

Sex differences in visuospatial mental rotation persist under 3D VR conditions

Poster Presentation - *Topic area: 3D Perception: Virtual environments*

Katerina Andrinopoulos[1] (kandrin@yorku.ca), Oliver Jacobs[2], Alan Kingstone[3], Jennifer Steeves[4]; [1]Centre for Vision Research, York University, [2]Psychology, University of British Columbia

The classic Shepard and Metzler (1971) mental rotation task showed a male advantage for visuospatial mental rotation of block structure images. This finding has been replicated numerous times and despite the ubiquity of the effect, some researchers question the ecological validity of the pen and paper task. One study rendered semi-immersive VR stereoscopic block structure images which eliminated this sex difference (Parsons et al., 2004). They generated 3D images with the ImmersaDesk stereo-goggle system and found no sex difference in ability to manually rotate a virtual object to the same spatial orientation as the previously seen target object. Here, we sought to re-examine potential sex differences in mental rotation ability using a novel VR adaptation of the original Shepard and Metzler mental rotation task with more capable and modern VR equipment (HTC VIVE). Our hypothesis was that using VR to generate 3D depth information in the block structures for mental rotation would yield sufficient additional structural information for the female observers to better complete the visual mental rotation task and thereby reduce the previously observed male advantage. Twenty-three female and 23 male participants indicated which two of four spatially rotated 3D blocks were the same as the target block. They were given unlimited time to complete the of stimulus consisting of 20 trials. We measured proportion correct as a function of sex of participant. Despite the VR set-up, we found a large male advantage, greater than is typically reported. These results stand in contrast to Parson's et al (2004) VR study which found no sex differences. However, because that study allowed participants to manually rotate the virtual images it likely assessed visuomotor spatial ability rather than pure visual spatial ability with mental rotation. Thus, the male advantage in pure mental rotation ability appears to persist even when presented in VR.

Acknowledgements: VISTA: Vision Science to Application, Canada First Research Excellence Fund, NSERC

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 794

The contribution of monocular cues to the perception of distance in virtual reality

Poster Presentation - *Topic area: 3D Perception: Virtual environments*

Rebecca L Hornsey[1] (rhorns@essex.ac.uk), Paul B Hibbard[1]; [1]University of Essex

We assessed the contribution of the pictorial cues of linear perspective, texture and scene clutter to the perception of distance using consumer virtual reality. In sparse environments, observers tend to underestimate the distance to far objects. As additional cues are made available, distance perception is predicted to improve, as measured by a reduction in systematic bias, and an increase in precision. We

assessed (1) whether space is nonlinearly distorted and (2) the degree of size constancy across changes in distance. In the first task, observers positioned two spheres, positioned at eye-height, in such a way that divided the space between the observer and an end reference stimulus (presented between 3 and 11m) into three equal sections. In the second task, observers set the size of a sphere, presented at the same distances and at eye-height, to match that of a hand-held football. Each task was performed in four environments. The first contained just a ground plane with a visible horizon. The second was a corridor defined solely by perspective cues. The third was the same corridor, with added textured walls and floor. The fourth environment contained object clutter, in addition to perspective and texture cues. We measured accuracy by identifying systematic biases in observers' responses, and precision as the standard deviation of these responses. While there was no evidence of non-linear compression of space, observers tended to underestimate distance. This bias was reduced when perspective cues were available, but no further improvement was seen when texture and scene clutter were present. Similarly, observers were the least precise in the sparse environment, with little improvement beyond the presence of perspective cues. These results show that linear perspective cues improve the accuracy and precision of distance estimates in virtual reality.

Acknowledgements: Economic and Social Research Council

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 358

The impact of motion gain on egocentric distance judgments from motion parallax

Poster Presentation - *Topic area: 3D Perception: Virtual environments*

Matthew Cutone[1] (cutonem@yorku.ca), Laurie Wilcox[1], Robert Allison[1]; [1]York University

For self-generated motion parallax, a sense of head velocity is needed to estimate distance from object motion. This information can be obtained from proprioceptive and visual sources. If visual and kinesthetic information are incongruent, the visual motion of objects will not match the sensed physical velocity of the head, resulting in a distortion of perceived distances. We assessed this prediction by varying the gain between physical observer head motion and the simulated motion. Given that the relative and absolute motion parallax would be greater than expected from head motion when gain was greater than 1.0, we

anticipated that this manipulation would result in objects appearing closer to the observer. Using an HMD, we presented targets 1 to 3 meters away from the observer within a cue rich environment with textured walls and floors. Participants stood and swayed laterally at a rate of 0.5 Hz paced using a metronome. Lateral gain was applied by amplifying their real position by factors of 1.0 to 3.0, then using that to set the instantaneous viewpoint within the virtual environment. After presentation, the target disappeared and the participant performed a blind walk and reached for it. Their hand position was recorded and we computed positional errors relative to the target. We found no effect of motion parallax gain manipulation on binocular reaching accuracy. In a second study we evaluated the role of stereopsis in counteracting the anticipated distortion in perceived space by testing observers monocularly. In this case, distances were perceived as nearer as gain increased, but the effects were relatively small. Taken together our results suggest that observers are flexible in their interpretation of observer produced motion parallax during active head movement. This provides considerable tolerance of spatial perception to mismatches between physical and virtual motion in rich virtual environments.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1426

UW Virtual Brain Project: Assessing Benefits of VR Education

Poster Presentation - *Topic area: 3D Perception: Virtual environments*

Melissa A. Schoenlein[1] (schoenlein@wisc.edu), Nathaniel Miller[1,2], Chris Racey[3], Simon Smith[1], Ross Treddinick[1], Chris Castro[1], Bas Rokers[2], Karen B. Schloss[1]; [1]University of Wisconsin-Madison, [2]New York University, Abu Dhabi, [3]University of Sussex

Virtual reality (VR) provides exciting avenues to engage students in learning about perceptual systems by providing immersive access to 3D neural structures. However, the educational benefits of VR are unclear. In the UW Virtual Brain ProjectTM, we developed VR lessons on visual and auditory pathways and assessed their effectiveness in controlled laboratory experiments and an undergraduate Perception course. In the laboratory, we compared learning, enjoyment, and ease-of-use when participants completed lessons using two platforms: VR (Oculus Rift) and 2D-monitor. In Experiment 1 (n=60) and a direct replication, Experiment 2 (n=101), pairings between platform, sensory-system (visual/auditory), and testing order were counterbalanced (2 platforms x 2 sensory systems x 2 orders). For each platform, participants completed a pre-test (drawing pathways and identifying structures), a lesson (visual or auditory system), and a post-test

(same as pre-test). Finally, participants completed a 7-item survey assessing enjoyment and ease-of-use. Coders naïve to pre/post-test and platform graded the tests. In both experiments, participants showed learning (post-test minus pre-test score, ps<.001), with no significant difference between VR and 2D-monitor lessons (Exp1, p=.118; Exp2, p=.068). The experience questionnaire items reduced to two dimensions (via Principle Components Analysis): “enjoyment” and “ease-of-use.” In both experiments, participants enjoyed VR far more than 2D-monitor lessons (ps<.001). In Experiment 2, VR was easier to use than 2D-monitor (p=.047), with no significant difference in Experiment 1 (p=.392). In the undergraduate course, we integrated visual and auditory VR lessons during lectures. After, students rated how much they thought VR lessons helped advance their progress on course learning outcomes. Students reported moderate to exceptional progress on all learning outcomes, with higher ratings for the outcome most aligned with VR lesson material (p<.001). Thus, VR has potential for innovating classroom education by providing active, enjoyable experiences that help achieve course learning outcomes.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1405

Attention: Aging, individual differences, disorders

Exploring Pupil Diameter as a Cognitive Spatial Filter

Poster Presentation - *Topic area: Attention: Aging, individual differences, disorders*

Ema Shamasdin Bidiwala[1], Miranda Scolari[1]; [1]Texas Tech University

Previous studies have successfully used changes in pupil diameter to index general top-down cognitive and attentional control. However, few studies have explored its ability to track the spatial extent of selective attention. To investigate this, subjects performed a modified flanker compatibility task with eye tracking, where performance is best facilitated by restricting spatial selection to the target item. To manipulate attentional spread, targets and distractors were presented in a common object (two rings connected by a line) or separately in (independent rings). Distractors were either compatible, incompatible, or absent. Pupil data was analyzed separately during a cueing period (rings alone) and after target onset, prior to response. Behaviorally the flanker effect (higher accuracy on compatible compare to incompatible

distractor trials) was equally significant across both grouping conditions. Furthermore, a simple linear regression across subjects revealed differences response time difference could be predicted by in pupil size during the cueing period between grouping conditions. A similar relationship was observed for distractor conditions after target onset, with larger pupil diameters on compatible conditions predicting faster responses than incompatible. Results on this task implicate pupil size as a general exertion of cognitive effort or effort related to spatial filtering. To elucidate these patterns, a second experiment was conducted manipulating spatial spreading of attention while holding cognitive effort constant. Subjects completed the aforementioned task, interleaved with a spatial inducer task eliciting a diffused or focused spread of attention. The inducer task allowed observation of spatial filtering ability when it was detrimental (diffused) or advantageous (focused). Preliminary results show presence of a flanker effect in focused conditions and absence in diffused. Consistent with results from the first experiment, spatial filtering seems to be related to exertion of cognitive effort. Both experimental results provide explanations for pupil behavior during exertion of cognitive effort in spatial tasks.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hello. Please feel free to contact at Ema.Bidiwala@ttu.edu for any questions or comments.

Abstract ID: 1677

Grandma, didn't you see that gorilla? Age effects in inattentional blindness during a hybrid foraging game

Poster Presentation - *Topic area: Attention: Aging, individual differences, disorders*

Beatriz Gil-Gómez de Liaño[1,2] (bgilgomezdeliano@bwh.harvard.edu), Makaela Nartker[3], Elena Pérez-Hernández[4], Jeremy M Wolfe[1]; [1]BWH-Harvard Medical, [2]Cambridge University, [3]Johns Hopkins University, [4]Universidad Autonoma de Madrid

In the Inattentional Blindness (IB) paradigm, observers, performing an attentionally demanding task, fail to see (or, at least to report) a highly salient stimulus. IB can be modulated by many factors, such as task difficulty, the similarity of the IB stimulus and the primary task stimuli, the spatial proximity of the IB stimulus and the primary task, and more. Factors related to the observers have an impact too (e.g. individual differences, attentional set variations, observer's interests, etc.). A modest number of studies have also suggested that children and older adults are more prone to IB. In the present study, we revisit the effect of age on IB, using a demanding but child-friendly hybrid-foraging task. In our task, observers memorized seven different images of stuffed animals. They had to collect instances of those targets in a

videogame-like task where about 120 animals moved around on the screen. After a few minutes, a cartoon gorilla, much larger than any other stimuli, appeared for about 16 seconds, crossing the screen from right to left. We tested five age groups: 5-6-year-old children, 11-12-year-old children, young adults (18 to 30-years-old), middle-aged adults (31 to 59-years-old) and older adults (over 60-years-old). When observers were subsequently asked about the appearance of the unexpected stimulus, over 85% of children reported having seen the gorilla, followed by about 75% of young adults, 50% of middle-aged adults, and only 20% of older adults. In this setting, it is the children who were least susceptible to IB, and older adults the most, with proportions in between for young and middle age adults. This may reflect differences in the degree to which a gorilla was "unexpected" at different ages, and/or how task-related and observer-related factors impact susceptibility to inattentional blindness.

Acknowledgements: European Union's Horizon 2020 research and innovation program, Marie Sklodowska-Curie Actions, under grant FORAGEKID 793268, granted to Beatriz Gil-Gómez de Liaño.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 448

Individual differences in visual attention: a short, reliable, open source, and multilingual test of multiple object tracking in PsychoPy

Poster Presentation - *Topic area: Attention: Aging, individual differences, disorders*

Hauke Meyerhoff[1] (h.meyerhoff@iwm-tuebingen.de), Frank Papenmeier[2]; [1]Leibniz-Institut fuer Wissensmedien, Tuebingen, Germany, [2]University of Tuebingen, Germany

Individual differences in attentional abilities provide an interesting approach in studying visual attention as well as the relation of attention to other psychometric measures. However, recent research has demonstrated that many tasks from experimental research are not suitable for individual differences research as they fail to capture these differences reliably. Here, we provide a test for individual differences in visual attention which relies on the multiple object tracking task (MOT) which captures the efficiency of attentional deployment. Within the task, the participants have to maintain a set of targets (among identical distractors) across a brief interval of object motion. Importantly, this test was explicitly designed and tested

for reliability under conditions that match those of most laboratory research (restricted sample of students, approximately n = 50). Test-retest reliability estimates revealed a high accordance in individual performances between two consecutive runs of the test (distinct sets of trials). For the full test (i.e. 15 min), we observed a reliability of r = .91. Nonetheless, reliability also remained high for shorter versions of the test (12 min: r = .87; 9 min: r = .83, 6 min: r = .81). In fact, even the shortest version of the test (i.e. 3 min) still revealed a reliability estimate of r = .69. The test is free to use and runs fully under open source software. In order to facilitate the application of the test, we have translated it into 16 common languages (Chinese, Danish, Dutch, English, Finnish, French, German, Italian, Japanese, Norwegian, Polish, Portuguese, Russian, Spanish, Swedish, Turkish). Given the high reliability estimates, we hope that this MOT test supports researchers whose field of study requires capturing individual difference in visual attention.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

This project has (very recently) been published as:

Meyerhoff, H. S., & Papenmeier, F. (in press). Individual differences in visual attention: A Short, reliable, open source, and multilingual test of multiple object tracking in PsychoPy. Behavior Research Methods.

Please feel free to contact me for questions/suggestions/comments.
Email: h.meyerhoff@iwm-tuebingen.de

Abstract ID: 854

Reduced attentional control in older adults leads to deficits in flexible prioritization of visual working memory.

Poster Presentation - *Topic area: Attention: Aging, individual differences, disorders*

Holly A. Lockhart[1] (hl10ze@brocku.ca), Emily E. Davis[1], Sarah E. Henderson[1], Stephen M. Emrich[1], Karen L. Campbell[1]; [1]Brock University

Visual working memory has been demonstrated to be flexibly distributed across sample items depending on each item's priority (Emrich, Lockhart, Al-Aidroos, 2017). This ability to flexibly prioritize information may depend on attentional control (Salahub, et al., in-press), which is the ability to select goal-relevant

target information and suppress goal-irrelevant non-target information from entering visual working memory. To test this hypothesis, we examined flexible prioritization in a group of older adults, a population known for impairments in attentional control. Participants performed a delayed-recall task in which the number and validity of simultaneously presented spatial cues was varied. On some trials, memory load was manipulated by presenting 1, 2, or 4 cues with 100% validity. In the flexible prioritization condition, 1 item was cued with a 50% valid cue. Errors were modeled with the three-component mixture model to distinguish precision, guess-rate, and non-target errors (Bays, Catalao, & Husain, 2009). In a sample of older adults (ages 65-85), recall precision was consistently lower, and guess-rate was consistently higher than in a group of young adults (ages 18-30) across all conditions. Importantly, older adults, but not young adults, also made significantly more swap errors when flexible prioritization demands increased but memory load remained constant. This deficit was most evident under the highest flexible prioritization demands: when an un-cued item was probed. These results suggest that flexible prioritization is impaired in those with reduced attentional-control. Moreover, these findings are consistent with work showing that working memory impairments observed in older adults are due to a mis-allocation of resources (Hasher & Zacks, 1988; Gazzaley et al., 2005).

Acknowledgements: This work was supported by the Natural Sciences and Engineering Research Council of Canada (Grant RGPIN-2017-03804 to KLC and Grant RGPIN-2019-04865 to SME)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Hello, I am a PhD student at Brock University, this project is a collaboration between the Visual Cognitive Neuroscience lab and the Neurocognitive Aging lab. This work is in preparation and I would love constructive feedback.

Abstract ID: 1269

State and short-term effects of mindfulness meditation training on attention

Poster Presentation - *Topic area: Attention: Aging, individual differences, disorders*

Raine Chen[1] (rainerrchen@uic.edu.hk), Zhenzhi Yang[1], Jiaqi Li[1], Mingzhan Wu[1], Xin Zhou[1], Xintong Xie[1], Wenjin Du[1], Liqiang Huang[2]; [1]BNU-HKBU United International College, [2]Chinese University of Hong Kong

Extensive mindfulness meditation has been widely supported in prior research for its beneficial effects on stress reduction and attention enhancement. Here we systematically examined the effects of mindfulness meditation training on various aspects of attention as well as how long-lasting the effects are. To investigate the state effects of mindfulness training on attention, we compared the baseline performance of 32 meditation novices (age range: 18-22, all non-gamers) on Attention Network Test (ANT) with their performance on the same task immediately after 30-min mindfulness meditation training (16 participants, 6 males) or 30-min action video game training (16 participants, 6 males). The findings indicate half an hour of both mindfulness and action video game training boosted participants' performance in the conflict monitoring subsystem of attention. More interestingly, the meditation group also showed significant improvement in the attention alerting subsystem whereas no such enhancement was observed in the action gaming group (group X test interaction: $p<0.05$). To further examine the short-term effects of mindfulness training on attention, we recruited another 18 meditation novices (age range: 18-22) and randomly assigned them either to receive six-week (around 30 hours in total) Mindfulness-based Stress Reduction training (n=9, 4 males) or to serve as waiting-list controls (n=9, 2 males). In the pre- and post-test of attention measurements, we used four different tasks, namely (1) ANT, (2) Multiple-object tracking, (3) Attentional blink and (4) Sustained attention. To separate state effects from the short-term effects, the post-test was arranged at least one day after the training. Training produced enhancement was only found in the alerting subsystem in ANT (group X test interaction: $p<0.05$) but not the other three attention tasks. Together, our findings suggest that the mindfulness training not only temporarily bolsters attentional alerting and conflict monitoring, but also induces long-lasting changes in the attentional alerting.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1815

The Resolution of Exogenous Spatial Attention Shifts is a Reliable Measure of Individual Differences

Poster Presentation - *Topic area: Attention: Aging, individual differences, disorders*

Chris Reynolds[1] (reynol89@uwm.edu), Adam S. Greenberg[2]; [1]University of Wisconsin Milwaukee, [2]Medical College of Wisconsin

Visuospatial selective attention is limited in spatial resolution (Intriligator & Cavanagh, 2001; He, Cavanagh, & Intriligator, 1996); that is, a quantifiable minimum spacing exists at which two nearby items can be isolated and selected for further processing. Previous research on attention resolution has focused on endogenous selection. Our goal was to measure the resolution of exogenous shifts of visuospatial attention. Participants viewed a circular array of equally-spaced, luminance-matched colored disks located at 10° eccentricity on a median gray background with a single RSVP stream rendered in white at fixation. Participants monitored the RSVP items for one or more target digits and responded via button press. Simultaneously, on each trial a black dot briefly (50 ms) appeared (among the peripheral colored disks) which exogenously captured attention. After each trial, participants selected via mouse-click the color (from an array of choices) corresponding to the location nearest to which the black dot had appeared on that trial. Group average results revealed that participants detected a majority of RSVP targets (51.73% hits). They also performed better than chance (~30%) at selecting the correct colored circle, and fell off approximately linearly with distance from the black cue. There was a large amount of variability between individuals, indicating that the resolution of exogenous attention is idiosyncratic. Furthermore, we found systematic differences in resolution between visual field quadrants. Nevertheless, individual participants showed strong consistency (low variability) over multiple samples at the same locations. These results suggest that the resolution of exogenous attention shifts may form a kind of attention fingerprint that describes an individual's ability to select crowded information at various peripheral locations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1580

Attention: Appearance, grouping

A Limiting Channel Capacity of Visual Perception: Spreading Attention Divides Perceptual Rates

Poster Presentation - *Topic area: Attention: Appearance, grouping*

Joseph S Lappin[1,2] (joe.lappin@vanderbilt.edu), Adriane E Seiffert[1], Herbert H Bell[2]; [1]Vanderbilt University, [2]Discerning Technologies LLC

How is the temporal process of perception affected by spreading attention to multiple objects? This study generalized the findings of another recent study, using different visual signals and a different detection task. Methods: During continuous watch periods, observers responded to sudden changes in either the color or direction of any one of a set of independently moving objects. The set size of moving objects was a primary variable. A simple detection task required responses to any display change, and a selective task required responses to a subset of the changes. Detection rates, in bits/s, were measured at successive times by response time (RT) hazard functions. Results: Increases in set size had a constant divisive effect on target detection rates. Moreover, variations in set size, visual target signals, and detection task exerted independent selective influence on detection rates at given times, reflecting continuous influence of parallel processes. Importantly, the divisive effect of increased set size was constant over time, invariant with rapidly changing detection rates controlled by the target signals and detection task. Conclusions: Contrary to conventional response time studies, the functional organization of these temporal processes was revealed by hazard functions but not by the RTs as such. The constant set size effects — invariant with response times, target signals, detection tasks, and with the developing influence of multiple component processes — indicate that conscious perception occurs at a measurable maximum rate, the result of a limiting channel capacity.

Acknowledgements: Phase II STTR contract (N00014-15-C-0024) on “Information Salience” from the Office of Naval Research to Discerning Technologies LLC; subcontract to Vanderbilt University.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 258

Attentional competition in perceptual and reflective attention: An fMRI study

Poster Presentation - *Topic area: Attention: Appearance, grouping*

Zachary J. Cole[1] (zachary.cole@huskers.unl.edu), Evan N. Lintz[1], Matthew R. Johnson[1]; [1]University of Nebraska-Lincoln

The frontal eye fields (FEF) are most strongly associated with eye movements and their planning, and have also been implicated in visual attention. In a previous study (Johnson & Johnson, 2009), we found that they were also activated by inward-directed (reflective) attention. In addition, when participants fixated on one stimulus and ignored another, the FEF were activated more than in a control condition that involved a greater number of eye movements. In the present study, we investigated both of those effects further, and

sought to more precisely delineate the similarities and differences between the perceptual and reflective attention networks. Participants were scanned while completing either a perceptual or reflective attention task. In both tasks, participants saw mixed pairs of items drawn from a set of face, scene, or noise images. In the perceptual attention task, participants were cued immediately beforehand either to fixate only on one image and ignore the other, or ignore both images. The reflective attention task was the same, except that the cues were presented immediately after the images. In the reflective attention task, participants kept their eyes at central fixation, and the post-cues instructed them to think back to (visualize) either one of the images, or neither image. Analyses of the fMRI data showed that activity in the FEF appeared to be modulated by the presence of visually meaningful competition that could not be explained just by the amount of visual information onscreen. Furthermore, the results replicate and extend previous findings indicating substantial overlap, but also substantial distinctions, between the perceptual and reflective attention networks.

Acknowledgements: NSF/EPSCoR 1632849

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

We would be really excited to discuss the project, follow-up ideas, or address questions further offline, or during a video chat! To initiate a conversation, please email Zachary Cole at zachary.cole@huskers.unl.edu

Thank you for showing interest in our work!
-Zach

Abstract ID: 1730

Detection of peripheral visual targets in 3D space is not affected by plane of fixation in a simulated driving context

Poster Presentation - *Topic area: Attention: Appearance, grouping*

Jiali Song[1] (songj16@mcmaster.ca), Hong-jin Sun[1], Patrick J. Bennett[1], Allison B. Sekuler[1,2,3]; [1]McMaster University, [2]Baycrest Health Sciences, [3]University of Toronto

A body of research suggests that attention along the depth-axis is concentrated along the line of sight up to the point of fixation and decreases rapidly beyond. However, most previous work used binocular disparity to simulate targets at distances within a few metres of the observer in peri-personal space, and therefore, little is known about how attention is allocated to targets located at far distances. Driving is a particularly

interesting context in which to examine attention along the depth-axis. First, objects commonly encountered while driving often are quite far from the driver. Second, attending to different distances is ecologically advantageous because events nearer to the driver have more immediate behavioural consequences. In the current study, we examined whether the distribution of attention along the depth-axis depends on the distance to the plane of fixation in a simulated driving context. In a virtual 3D environment where distance is simulated by pictorial cues and optical flow, participants followed a lead car. To manipulate fixation distance, participants maintained a constant following distance of either 9.25, 18.5, or 37 m. Attention along the depth-axis was assessed with a detection task where targets matched in retinal size could appear at one of three distances (9.25, 18.5, 37 m) and two eccentricities (12, and 24 degrees). Preliminary results indicate that detection was slower for far targets (37 m) compared to the other two distances, and detection was slower and less accurate for targets at an eccentricity of 24 deg compared to 12 deg at all target distances. Finally, car-following distance did not modulate the effects of target distance and eccentricity, although there were fewer misses and faster reaction times in the intermediate car-following distance condition. These results suggest that the effect of distance in far space may be different from that in peri-personal space.

Acknowledgements: We acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

Scheduled Conference times (EDT):
June 19th, 17:00
June 20th, 15:00
June 22th, 9:00
Link: https://us02web.zoom.us/j/2864588914?pwd=ZncwdWdKZGZGeUcyUDJJRVRSQVdHZz09

Abstract ID: 1547

Does eye-specific attention act as a gateway to conscious perception?

Poster Presentation - *Topic area: Attention: Appearance, grouping*

Cheongil Kim[1] (kimcheongil@gmail.com), Sang Chul Chong[1]; [1]Yonsei University, Seoul, Republic of Korea

The relationship between attention and conscious perception is an important topic in understanding mechanisms of conscious perception. Hypotheses emphasizing the role of cognitive access in conscious perception argue that attention and conscious perception are closely related. On the other hand, hypotheses separating conscious perception from cognitive access argue that attention and conscious perception are dissociable. To investigate the relationship between attention and conscious perception, studies have used a spatial cueing paradigm that compares conscious reports (e.g., visibility rating) on cued and uncued trials. Spatial cueing, however, has a limitation because observers have awareness of which trial is the cued or uncued trial, which can affect decision criteria of conscious report regardless of conscious perception of a target. To solve this problem, we used a monocular cueing paradigm. A monocular cue can attract eye-specific attention to a cued eye, but observers have no awareness of which eye received the cue and thus they do not know which trial is cued. In the present study, the effect of eye-specific attention was tested by comparing objective performances (i.e., orientation discrimination of a Gabor patch) between cued and uncued trials where a target was presented to the cued and uncued eyes respectively. At the same time, we compared conscious reports (i.e., visibility rating of a Gabor patch) to investigate whether eye-specific attention can modulate conscious perception. We found that eye-specific attention enhanced both objective performances and conscious reports of a target. Through an additional experiment that compared conscious reports when objective performances were matched between the cued and uncued trials, we again found that the effect of eye-specific attention on conscious perception is difficult to separate from the effect on objective performances. Our results suggest that attention and conscious perception are closely related, and that attention can act as a gateway to conscious perception.

Acknowledgements: This research was supported by the Brain Research Program of the National Research Foundation (NRF) funded by the Korean government (MSIT) (NRF-2017M3C7A1029658).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 482

Event-based attention: Selective attention can operate interactive biological motions as a unit

Poster Presentation - *Topic area: Attention: Appearance, grouping*

Huichao Ji[1] (jihch@mail2.sysu.edu.cn), Jun Yin[2], Yushang Huang[1], Xiaowei Ding[1]; [1]Sun Yat-sen University, [2]Ningbo University

How does selective attention navigate us to people-related information in the social world, for example, to find the same solitary person as a partner in a grand dancing party? According to the prevalent object-based attention theory, single person can be selected as a unit and guide attention, and this theory has received numerous supports in the past thirty years including both behavior and neurophysiological evidence. However, in real-world scenes, we need to detect more social information, such as whether people are involved in social interactions. We thus proposed a new concept of event-based attention that interacting social events can be the elementary unit of selective attention. We examined these two different theories using a paradigm modified from classic two-rectangle cuing paradigm. Observers looked at the four upright biological motions interacting in pairs (paired condition) or not (unpaired condition), and discriminate whether the probe was “T” or “L” after a cue on one agent (Experiment 1). Results indicated a “same-event advantage” only in paired condition: performance was better for probes presented on the same-event agent, compared to probes presented on the equidistant agent but involved in a different event. There was no such difference in inverted biological motions (Experiment 2), excluding any possible influence of low-level features. We thus concluded that interacting social events can serve as the elementary units of selective attention.

Acknowledgements: Humanities and Social Sciences Foundation of the Ministry of Education of China (19YJA190004) and Fundamental Research Funds for Colleges and Universities-Key Training Program for Young Teachers(19wkzd23)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

Huichao Ji: jihch@mail2.sysu.edu.cn
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Xiaowei Ding: dingxw3@mail.sysu.edu.cn

Abstract ID: 203

Evidence for the involvement of perceptual grouping in flanker effects through random dot kinematograms (RDKs).

Poster Presentation - *Topic area: Attention: Appearance, grouping*

Jordan Deakin[1], Dietmar Heinke[2]; [1]University of Birmingham

The Eriksen flanker effect refers to the slowing of responses to targets with known location when flanked by items associated with a different response. Typically, this effect is explained through response competition resulting from the attentional integration of perceptual features of incongruent flankers. Since the delay is more pronounced when target and flankers are closer together, the attentional integration is assumed to operate like a zoom lens. Here, we present a novel flanker paradigm where the stimuli consist of random dot kinematograms (RDKs). Using RDKs, the strength of the perceptual evidence can be manipulated by modifying the percentage of coherently moving dots. While we were able to replicate the classic flanker effect with low coherent RDKs, the effect decreased with increasing coherence, suggesting that the flanker effect is not only due to competition at the response stage but also involves a perceptual stage. Surprisingly, and contrary to the zoom lens model, we found no flanker effect in a second experiment where target-flanker spacing was reduced. We interpret these results as evidence for the involvement of perceptual grouping in the attentional integration of flankers. We assume that responses are facilitated when flankers can be grouped and perceptually segregated from the target. Following the Gestalt principles, this segregation is most effective when target and flankers are dissimilar. In our experiments, lower coherence increases target-flanker similarity, leading to less efficient segregation and in turn a stronger flanker effect. Furthermore, the beneficial effect of reduced target-flanker spacing is explained through the Gestalt law of grouping by proximity, where close flankers are more strongly grouped leading to a reduction of the flanker effect. Together, these results suggest attention can be guided by perceptual groups capable of moderating the detrimental influence of incongruent flankers on response execution.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

**Correction: In the 'participants' section of the poster, the two spacing conditions are 1˚ and 0.2˚:

1˚ Target-Flanker Separation: 19 students from the University of Birmingham (5 males, 14 females, mean age: 21.84 years).

0.2˚ Target-Flanker Separation : 18 students from the University of Birmingham (10 males, 8 females, mean age: 20.94 years).

Abstract ID: 666

Feature-binding errors during saccadic remapping may affect perception of real-world objects

Poster Presentation - *Topic area: Attention: Appearance, grouping*

Christopher M Jones[1] (jones.6475@osu.edu), Julie D Golomb[1]; [1]Ohio State University

Our eyes are constantly moving, jumping from one location to another, and yet we perceive our world as stable. Immediately after a saccade, attention has to remap from the previous "retinotopic" eye-centered location to the current "spatiotopic" world-centered location. Previous work has shown that when attention remaps after a saccade, it is briefly split between the previous retinotopic location and the current spatiotopic location. Researchers investigating this phenomenon have found that during this remapping period, perception of objects such as colored squares or colored, tilted bars can be subject to feature-binding errors such color mixing, illusory-conjunctions, and unbound-errors (Dowd & Golomb, 2019; Golomb, L'Heureux, & Kanwisher 2014). However, it is unknown what the consequences of feature degradation during remapping may be for perception of real-world objects. To investigate this question, we conducted an experiment in which participants viewed four colored objects presented simultaneously after either a short (50ms) or long (500ms) delay following completion of a saccade. Before making the saccade, participants attended a cued spatiotopic location, and then reported the color and identity of the object (e.g., a red car) presented at that cued location. Participants were overall less accurate for both color and object reports in the short-delay condition compared to trials with a long delay, in which there was sufficient time for remapping. Moreover, when participants made errors in the short-delay condition, they were more likely to make certain types of binding errors, such as illusory-conjunctions between the spatiotopic color and a non-target object, or reporting the correct spatiotopic target color with an object not originally present in the display. Participants also made unbound errors such as reporting the identity of the retinotopic object, but guessing on color. Overall, our results imply that saccadic remapping may have implications for the perception of real-world objects.

Acknowledgements: NIH R01-EY025648 (JG), NSF 1848939 (JG)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 595

Attention: Bottom-up and top-down

Assessing introspective awareness of overt attentional capture

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Owen Adams[1] (oadams2@binghamton.edu), Nicholas Gaspelin[2]; [1]Binghamton University (SUNY), [2]Binghamton University (SUNY)

Recent research indicates that observers can learn to inhibit attentional capture by physically salient stimuli. A key question is how individuals learn to do this, especially in real-world scenarios without direct feedback about performance. One possibility is that participants have internal awareness of capture immediately after it occurs. This introspective awareness could then be used to adjust performance strategies in order to avoid subsequent capture. However, it is unclear whether observers actually have the ability to internally monitor attentional capture. In the current study, participants performed an additional singleton paradigm modified for eye tracking. Participants searched for a target shape and attempted to ignore a color singleton distractor. On a subset of trials, participants were immediately asked to report whether the color singleton captured their attention during the preceding search task ("capture" vs. "no capture"). Crucially, first saccades were more frequently directed to singleton locations on "capture" report trials than "no capture" report trials. In fact, oculomotor capture effects were nearly twice as large on trials where participants reported "capture" than trials where they reported "no capture." These results directly demonstrate that observers can internally detect oculomotor capture, at least under certain circumstances. This may be an important training tool for future research on learned inhibition of salient distractors.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 334

Attentional capture by flicker frequency

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Moritz Stolte[1] (moritz.stolte@univie.ac.at), Ulrich Ansorge[1]; [1]University of Vienna

Visual motion captures attention, but little is known about the automaticity of these effects and the time required for the integration of motion signals to capture attention. Here, we tested if deviant frequencies as one form of motion automatically capture attention and whether integration across time results in a longer period of effective cueing by flicker than by single-transient cues. Observers searched for a vertical target among tilted distractors. Prior to the target display, a cue array of sinusoidally modulating annuli, each surrounding one location of the subsequent target (-plus-distractors) display was presented for variable durations. Annuli either flickered all at 1 Hz (no-singleton cue), or a single annulus flickered at a unique frequency of 5 Hz, 10 Hz, or 15 Hz. The location of this singleton-flicker cue was uncorrelated with target location. Thus, we could measure benefits (target at cued location) and costs (target ≠ cued location) for cues of different frequencies and durations. The results showed that deviant flicker frequencies capture attention, as we observed benefits and costs, falsifying that nonspatial filtering accounted for the cueing effect. In line with automatic capture, cueing was effective in a singleton (Experiment 1) and a non-singleton search task (Experiment 2), and is thus not due to top-down singleton search. Moreover, results held in analyses ruled out trial-by-trial 'swapping' of flicker frequencies at target and distractor locations. Results also revealed significant capture for cues with frequency separations from non-singleton flicker as low as 4 Hz at short cue durations (180 ms) and increasing cueing effects with higher cue frequencies and longer durations. This indicates a significantly longer period of automatic capture by sinusoidal flicker (up to 360 ms) than the typical inhibition of return observed ~250 ms after the onset of uninformative static or single-transient cues.

Acknowledgements: This research was funded by The Austrian Research Promotion Agency (FFG - 'BRIDGE 1') in cooperation with ZKW Group (ZKW)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1743

Evidence for suppression of irrelevant distractors in early visual cortex

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Kirsten Adam[1] (kadam@ucsd.edu), John Serences[1]; [1]University of California San Diego

Competing theories of visual search make diverging claims about whether we can suppress salient but irrelevant information and, if so, where in cortex attentional priority maps reside. Here, we used fMRI to assess whether the representation of a salient distractor can be suppressed below baseline in early visual

cortex. Subjects (n = 12) performed an additional singleton search task in which they searched for a target (e.g., green diamond) amongst non-singleton distractors (e.g., green circles); an irrelevant color singleton distractor (e.g. red circle) appeared on 75% of trials. We manipulated trial history to induce attentional capture ("color variable", colors swapped unpredictably) or to eliminate capture ("color constant", colors were fixed). Using a spatial encoding model and fMRI, we estimated the representation of each item's location in the 4-item search array. When participants were behaviorally captured ("color variable" condition), we observed that model-based estimates of the target and distractor locations were stronger than the non-singleton distractor location in early visual cortex (V1-V3), $p < .01$. and in IPS0-3, $p < .005$. When participants were not behaviorally captured ("color constant" condition), we observed that model estimates of nearby singleton distractor locations were suppressed below the level of non-singleton distractors in early visual cortex (V1-V3, $p < .01$) and some other visual areas (e.g., hV4-VO2, $p < .05$; IPS0-3, $p < .01$), consistent with the signal suppression hypothesis. Furthermore, model-based estimates of distractor suppression related to behavior. On fast trials (i.e., successful suppression), there was robust suppression of the irrelevant singleton distractor below the non-singleton distractor baseline ($p < .005$). This suppression was not observed for slow trials in this condition ($p = .28$). Our findings support accounts in which successful suppression leads to the down-weighting of distractors in spatial priority maps throughout visual cortex, bolstering evidence from EEG and eye-tracking studies.

Acknowledgements: NEI grant R01 EY025872 (J.S.) and NIMH grant T32 MH020002 (K.A.)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 199

Finding the Explanatory Limits of the eSTST Model of the Attentional Blink

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Shekoofeh Hedayati Zafarghandi[1] (shokoufeh.hed@gmail.com), Brad Wyble[1], Natalie Russo[2]; [1]Pennsylvania State University, [2]Syracuse University

The Attentional Blink (AB) phenomenon (i.e. missing a second target presented 100-500ms after a first target; Raymond et.al.,1992) has been studied to understand the temporal dynamics of attentional deployment. Along with conducting behavioral experiments, models of the AB have been developed to provide computationally and neurally plausible explanations of its underlying mechanisms. However, manipulating experimental parameters (stimulus type, presentation duration, etc.) gives rise to various patterns of the AB that are quantitatively and qualitatively distinct. How can we know the explanatory limits of a model for different data sets? To understand how well a set of AB data can be simulated by a particular model, and also to gain insight into how the model's parameters map onto the data, we designed an automated algorithm that searches parameter space to find the best set of parameters. We utilized the episodic simultaneous type serial token (eSTST) model of the AB (Wyble Bowman & Nieuwenstein, 2009) and chose three specific parameters that modulate the shape of a simulated AB curve. The search algorithm was based on the Markov Chain Monte Carlo (MCMC) which tried to fit both quantitative (i.e. mean squared error) and qualitative (i.e. features that are vital to the theory of AB such as AB depth, lag-1 sparing, etc.) features of the two AB data sets. The algorithm was fit to two AB data sets demonstrating different patterns. The parameter search performed on the eSTST model revealed that the model was unable to account for data that contained no lag-1 sparing. Furthermore, given that the chosen parameters of the eSTST corresponded to distinct constructs of the visual working memory, the algorithm was informative on how these parameters were mapped onto each data set. This mapping, in turn, allowed for making inferences of the role of these constructs in mediating the AB.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have any questions about the poster and cannot meet in zoom, feel free to contact me via email (suh437@psu.edu) or via the chat option provided here!

Abstract ID: 1315

Laminar origins of the N2pc index of visual attention in area V4

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Michelle Schall[1] (michelle.schall@vanderbilt.edu), Jacob Westerberg, Alexander Maier, Jeffrey Schall, Geoffrey Woodman; [1]Vanderbilt University

Research into mechanisms of visual attention in humans has relied on an event-related potential known as the N2pc, because it indicates where and when attention is allocated. The N2pc was discovered and characterized in humans, and its neuronal generators are uncertain. Several investigators have conjectured that extrastriate visual area V4 can be a generator of the N2pc based on the similarity of patterns of

modulation. Our group has been investigating that conjecture. We have established that the N2pc manifests in macaque monkeys performing visual search. We have established that inverse solutions of the N2pc identify a current generator in the vicinity of V4. Now, to determine most directly whether V4 contributes to the generation of the N2pc, we performed laminar recordings of area V4 concurrent with extracranial EEG in macaque monkeys performing visual search for a singleton. A target stimulus (red or green) was presented among several distractors (homogenous green or red) in an array around a central fixation point. Monkeys shifted gaze to the singleton to earn fluid reward. With field potentials recorded across all cortical layers, we calculated current source density (CSD) of net synaptic depolarizations. On a trial-by-trial basis we compared the magnitude of CSD and polarization of the N2pc. Trial-to-trial variability in the synaptic depolarizations of V4 explained a significant amount of variance in the extracranial voltage fluctuations during the N2pc in a layer-specific manner. These results demonstrate for the first time that V4 contributes to the N2pc.

Acknowledgements: P30EY008126, R01EY019882, R01EY027402, R01EY008890, T32EY007135, U54HD083211, Nvidia Corporation, E. Bronson Ingram Chair in Neuroscience

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 299

Saliency Map Predictions of DeepGaze II are Influenced by the Convolutional Neural Network Texture Bias

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Charlotte A. Leferink[1], Dirk B. Walther[1,2]; [1]Department of Psychology, University of Toronto, [2]Samsung Artificial Intelligence Center Toronto

Though line drawings depict edges of objects and not texture nor colour, which is typically present in the natural environment, humans can recognize scenes depicted in line drawings just as well as those in colour photographs. It has been shown recently that most convolutional neural networks (CNNs) rely on texture more than they rely on edges and shapes of the objects depicted in an image. But what are the effects of these model constraints on modelling visual attention? Here we show that, like humans, a leading CNN-based model of spatial attention, DeepGaze II, generalizes well between photographs and edge-extracted images. Seemingly innocuous low-level changes, however, such as reversing the contrast polarity of the

edge-extracted images, cause vastly different predictions by the attention model. This is not the case for human observers, since contrast polarity reversal maintains the structure and global properties of the objects within an image. These results provide further evidence of the reliance of CNNs on texture-based visual information for generating its predictions. To further explore these questions, we recorded eye movements of participants viewing edge-extracted versions of the images from the MIT1003 dataset, which serves as ground truth for DeepGaze II. Comparisons of predicted gaze maps generated from line drawings and from photographs with human fixations on line drawings and photographs showed that both humans and the model generalize well between those drastically different representations of the scenes. Changing contrast polarity of the drawings, on the other hand, drastically changed the predicted gaze maps. Our unique eye movements data set and analysis procedures allow us to further explore the limitations of the CNN texture bias, and to further investigate the capacity of CNNs to learn global shape representations as they apply to directing visual attention.

Acknowledgements: This work was supported by an NSERC Discovery Grant (#498390) and the Canadian Foundation for Innovation (#32896) to DBW.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 963

The influence of eye blinks on attention in a spatial cueing paradigm

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Egor Ananyev[1] (egor.ananyev@gmail.com), Jit Wei A. Ang, Gerrit Maus; [1]Nanyang Technological University

Humans blink approximately 20 times per minute, much more than seems to be physiologically necessary. The eye blink rate also varies depending on the task and cognitive demand, suggesting a link between eye blinks and attention. Here, we investigate this using a classical spatial cueing paradigm (Posner, 1978). Participants were prompted to blink in the period between a spatial cue and the target (presentation sequence: cue – blink – target; CTOA range of 640 to 900 ms). This was compared with two control conditions: no blinks and artificial blinks (shutter goggles). The spatial cues were either unpredictive (50% valid) or predictive (75% valid) of the subsequent target's location, corresponding to involuntary and voluntary attention, respectively. When the cue was unpredictive, there was a slowing of the response to the target in the validly cued location (Inhibition of Return), regardless of the blink condition. However,

when the cue was predictive, blinks were associated with a shortened reaction time to the validly cued target compared to the control conditions. Furthermore, the spatial cueing benefit increased with longer eye blinks. These results suggest that blinks affect top-down, voluntary attentional engagement.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for your interest in my poster! Please leave your comments in the Chat, and I will respond as promptly as I can.

ERRATUM: The first bullet point in the Conclusion should say:
"Eye blinks were associated with a cueing benefit specific to voluntary, but not involuntary, spatial attention."

Abstract ID: 478

Tracking Flanker Task Dynamics: Evidence for a Continuous Implementation of Selective Attention

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Kaleb T. Kinder[1] (kalebkinder24@gmail.com), A. Caglar Tas[1], Aaron T. Buss[1]; [1]University of Tennessee, Knoxville

Selective attention is typically studied with tasks that ask participants to identify relevant information (the target) for further processing while ignoring distractors. In cases where the target and distractors contain conflicting information, reaction times (RTs) are reliably slower compared to when there is no conflicting information, suggesting that attentional selectivity requires additional time to be deployed. How selective attention unfolds over time, however, is currently debated. There are two main accounts that explain temporal dynamics of attentional selectivity: one proposes that attentional selectivity increases continuously over time (Heitz & Engle, 2007), and the other proposes that attention transitions from a low- to a high-state of selectivity at a discrete point in time (Hübner, Steinhauser & Lehle, 2010). While both accounts successfully explain RT data, there is no direct empirical evidence that distinguishes them. In the present study, we utilized mouse-tracking to record real-time response trajectories in a flanker task. On each trial, participants were presented with five colored stimuli where the identity of the central target corresponded to one of two response locations. The task was to move the mouse cursor and click on the correct response location. The target was flanked by distractors that were either the color of the opposite response mapping (incongruent), a color that was unassociated with a response mapping (neutral), or the

same color (congruent). Replicating previous studies, we found slower RTs for incongruent trials compared to neutral trials. Furthermore, response trajectories for incongruent trials curved more toward the incorrect response location compared to neutral trials, suggesting greater distractor interference on selective attention. Importantly, our results showed that this attraction to the incorrect location evolved gradually over time and smoothly transitioned toward the correct response location, as opposed to abruptly shifting at discrete points in time, demonstrating a continuous implementation of selective attention.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
21 June, 5:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1359

Typicality Modulates Attentional Capture by Object Categories

Poster Presentation - *Topic area: Attention: Bottom-up and top-down*

Y. Isabella Lim[1] (isabella.lim@mail.utoronto.ca), Andrew Clement[1], Jay Pratt[1]; [1]University of Toronto

What we pay attention to in our visual environment is often driven by what we know about the world. For example, when we search for objects in our environment, we often adopt a target template based on an object's category membership rather than its specific visual features. Categorical information informs humans of how objects may be grouped, and our mental representation of categories is thought to be based on exemplars, or the most typical member of a particular category. While the typicality of objects can assist in target identification in visual search, it is unknown whether typicality also affects attentional capture by object categories. To test whether this is the case, participants were given a category of objects at the beginning of each trial. A rapid stream of images was then presented at fixation, and participants were asked to indicate whether a member of the target category was present or absent from the stream. On each trial, a distractor also appeared beside the stream just before the target image. This distractor could belong to the same category or a different category than the target image, and could be a typical or atypical member of either category. Our results showed that when this distractor belonged to the same category as the target image, participants were worse at indicating the presence of the target image. Thus, objects that belonged to the same category as participants' target template captured attention. Importantly, typical distractors that belonged to the same category as the target image resulted in worse

accuracy than atypical distractors. This suggests that the extent of attentional capture towards a distractor can depend on whether the distractor matches one's target template in terms of category identity and typicality.

Acknowledgements: NSERC 2016-06359

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 467

Attention: Capture, suppression

An attentional bottleneck in visual object perception

Talk Presentation - *Topic area: Attention: Capture, suppression*

Dina V. Popovkina[1] (dina4@uw.edu), John Palmer[1], Geoffrey M. Boynton[1]; [1]University of Washington

For some simple visual tasks, we can make judgments about multiple stimuli in parallel, while for some complex visual tasks we can make only one judgment, showing a complete attentional bottleneck. We asked whether an attentional bottleneck limits performance for a task of intermediate complexity: the semantic categorization of visual objects. Stimuli appeared above and below fixation in rapid serial visual presentation (RSVP), and observers were cued that either one ("single-task") or both ("dual-task") objects were relevant. The stimuli were grayscale photographs of isolated nameable objects, and observers judged whether the cued object belonged to a target category (e.g. "animal"). The difference in performance between the single- and dual-task conditions ("dual-task deficit") was compared to quantitative model predictions. A bottleneck is implemented as an all-or-none serial model (observers can only judge one stimulus at a time, producing a large dual-task deficit). We also considered an independent parallel model (observers can judge two stimuli as accurately as they can judge one) and a fixed-capacity parallel model (a constant amount of information extracted). Results from 9 participants showed a large dual-task deficit (12 ± 1%), most consistent with a bottleneck. Additionally, a bottleneck makes a distinct prediction for responses within a dual-task trial: a given response is more likely to be incorrect when the response about the other stimulus is correct. In contrast, parallel models predict no difference in performance based on the response to the other stimulus. Our data show this difference, consistent with the bottleneck prediction (Δ

= 0.04 ± 0.01). We repeated this experiment using a simplified presentation (masking instead of RSVP); results from 6 participants showed the same large dual-task deficit (12 ± 1%). Our findings thus support the presence of a bottleneck for categorization of nameable visual objects, and reject the specific parallel models considered here.

Acknowledgements: This work was supported by NIH NEI grant RO1-EY12925 to GMB and JP.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 974

How do we measure attention? Visual cognition meets neuropsychology

Talk Presentation - *Topic area: Attention: Capture, suppression*

Todd S. Horowitz[1] (todd.horowitz@nih.gov), Melissa Treviño[1], Xiaoshu Zhu[2], Yi Yi Lu[3,4], Grace C. Huang[2], Laura T. Germine[3,4]; [1]Basic Biobehavioral and Psychological Sciences Branch, National Cancer Institute, [2]Westat, [3]Institute for Technology in Psychiatry, McLean Hospital, [4]Department of Psychiatry, Harvard Medical School

Do neuropsychological tests commonly used to assess attention in clinical populations measure the same construct as experimental attention tests? We followed up a factor analysis by Huang et al. (2012), who proposed that many visual cognition attention paradigms load on a “general attention factor”, a. Adult participants (N = 488) completed a comprehensive 90-minute on-line battery (TestMyBrain.org). Five visual cognition paradigms (Multiple Object Tracking (MOT), Flanker Interference, Visual Change Detection (VCD), Approximate Number Sense (ANS), L/T Visual Search Task) were selected to match the general attention factor. We included the Gradual Onset Continuous Performance Task (Grad CPT), hypothesizing that some neuropsychological tests might be measuring sustained rather than selective attention. Neuropsychological tests, selected according to popularity in the domain of cancer-related cognitive impairments (Horowitz et al. 2019), comprised Trail Making Test versions A & B (TMT), Digit Symbol Substitution (DSS), Forward and Backward Digit Span, Letter Cancellation, Spatial Span, and Arithmetic. We obtained a four-factor solution: (1) GradCPT, MOT, VCD, and ANS, along with Spatial Span and DSS; (2) Digit Span Forward and Backward; (3) TMT A & B, Letter Cancellation, and Visual Search; (4) Arithmetic. Flanker Interference did not load on any factor. These results do not fully replicate a, as Visual Search and Flanker Interference were not related

to other attentional paradigms. Of neuropsychological measures, Spatial Span and DSS were related to the main attention factor, while those with a search component (e.g., TMT) were related to Visual Search. These results help us to understand the structure of our visual attention paradigms, and to connect visual cognition to neuropsychology. We recommend that clinical studies should be cautious about attributing attention deficits; Digit Span, for example, should not be characterized as an attention measure. Visual search may be distinct from other attentional paradigms.

This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 537

Multiple salience maps

Talk Presentation - *Topic area: Attention: Capture, suppression*

George Sperling[1] (sperling@uci.edu), Peng Sun[1], Veronica Chu[1]; [1]University of California, Irvine

The centroid task requires subjects to use a mouse to indicate the center of a briefly flashed cloud of, typically, dots. Subjects can also judge the centroid of a cloud of highly diverse items that differ in color and shape. Similarly, subjects can judge motion direction in successive frames in which the only thing that changes consistently is an area defined as figure, the substance of both figure and ground changing in each new frame. The fact that subjects can make centroid, motion direction, and other judgments that simultaneously involve the locations of highly different items defined merely as figure versus ground suggests that these computations act on a salience map that records the presence and the location of items but is indifferent to their substance. In motion and centroid tasks, Ss can also selectively respond to attention-selected subsets of items and ignore distracter items. Here we show that, in a single brief flash of either 12 or a 24 dot cloud, with equal numbers of interleaved black, red, and green items, subjects can accurately report the centroids of all three colors. Their performance is further analyzed in terms of three computationally defined components: accuracy of their 3 attention-defined color filters, the fraction of stimulus items incorporated into the centroid computation (efficiency), and mouse misplacement error. Comparing triple response and single-response controls shows: no loss in the quality of 3-versus-1 attention filters, only a 6% overall efficiency loss in judging 3-versus-1 4-dot centroids, and a 20% efficiency loss in 3-versus-1 8-dot centroids. That three centroid computations can occur concurrently with no loss in

the quality of the attention filter and only minor losses in overall efficiency requires a reformulation of the single salience map concept: Our subjects exhibit three concurrently active salience maps.

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 429

Spatial cueing effects do not necessarily index spatial shifts of attention

Talk Presentation - *Topic area: Attention: Capture, suppression*

Dominique Lamy[1] (domi@tauex.tau.ac.il), Itay Yaron[2], Elinor Hadas[3]; [1]Tel Aviv University

Many attentional capture studies rely on the spatial-cueing paradigm to elucidate what factors guide attention, yet have yielded conflicting findings. These studies assume that faster responses for targets appearing at a cue's location indicate that this cue captured attention and was therefore mandatorily processed. Here, we challenge this canonical interpretation of spatial cueing effects. Participants searched for a color-defined target among distractors, following a spatially uninformative color cue. In Study 1, the cue either shared or did not share the target color and the distractors' similarity to the target was varied. Spatial-cueing effects were observed even when other indices revealed that attention was not allocated to the cue. The salience of the successive objects occurring at a given location and how similar they were to the target jointly determined where attention was allocated. These findings show that spatial-cueing effects do not necessarily index attentional shifts but instead reveal the extent to which the cue speeds the resolution of the competition between the target and distractors. In Study 2, we investigated what event triggers attentional deployment: the detection of the target feature or the search context. We used two independent response-compatibility manipulations to measure when attention was deployed: early, following the cueing display or later, following the search display. The pattern of response compatibility effects revealed that enhanced processing accrued only to the distractor that appeared at the cued location in the search display, and not to the cue. Taken together, these findings support the Priority Accumulation Framework (PAF), which suggests that attentional priority weights accumulate across time and that instead of relentlessly shifting our attention to potentially irrelevant events, we wait for clues that the appropriate

moment has arrived to deploy our attention to the highest-priority location. Our interpretation of spatial cueing effects resolves enduring inconsistencies in the attentional-capture literature.

This talk will be presented in Live Talk Session 6, Tuesday, 23 June, 7:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1141

The Pd component reflects suppression of salient distractors below baseline

Talk Presentation - *Topic area: Attention: Capture, suppression*

Tobias Feldmann-Wüstefeld[1] (tobias.fw@gmail.com), Niko A. Busch[2], Anna Schubö[3]; [1]University of Southampton, [2]University of Münster, [3]Philipps-University Marburg

Both enhancement of relevant and suppression of irrelevant information contribute to visual selective attention. Suppression of irrelevant salient stimuli is particularly helpful as it prevents attention to be captured and thus attentional resources to be wasted. It was suggested that the Pd (distractor positivity) component in the event-related potential of the EEG reflects such active suppression. This study aimed at directly connecting the Pd component to failures to suppress salient distractors. Participants performed a visual search task in which they had to report the digit of a diamond-shaped target while ignoring circular distractors. One of the distractors could have a unique color (an additional singleton), rendering it particularly salient. Not just the target, but all distractors had a unique digit embedded. Thus we could deduct from a participant's response which item they attended. Reports of target digits served as a behavioral index of enhancement, and reports of color distractor digits served as a behavioral index of failed suppression, each measured against reports of neutral distractor digits serving as a baseline. We measured participants' EEG signal while they performed the task to identify the underlying neural mechanisms of suppression. In line with previous results, participants reported the target identity more often than any distractor identity and the color singleton identity least often, suggesting suppression of the singleton below baseline. Importantly, when the singleton identity was not suppressed but reported, the Pd was observed in a later time window. This suggests that the Pd reflects suppression of salient distractors

below baseline. Interestingly, singletons also elicited a contralateral delay activity (CDA) when they were reported, indicating that the erroneous encoding of singletons into working memory may contribute to behavioral errors. Our results provide evidence for the signal suppression hypothesis that states salient items have to be actively suppressed to avoid attentional capture.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1242

Attention: Distraction, load

Distracted by affective pictures: Neural mechanisms revealed by multivariate pattern analysis

Poster Presentation - *Topic area: Attention: Distraction, load*

Ke Bo[1] (dibanboye@ufl.edu), Nathan Petro[2], Changhao Xiong[1], Andreas Keil[3], Mingzhou Ding[1]; [1]J Crayton Pruitt Family Department of Biomedical Engineering, University of Florida, [2]Department of Psychology, University of Nebraska at Lincoln, [3]Department of Psychology and the NIMH Center for Emotion and Attention, University of Florida

Affective pictures are highly potent distractors. In this study we examined the impact of picture valence on task-relevant visual processing and the underlying neural mechanisms. Simultaneous EEG-fMRI were recorded while participants detected instances of coherent motion in a random dot kinematogram (RDK) overlayed on IAPS pictures (positive=erotic couples, neutral=workplace people, and negative=bodily mutilations). RDK and IAPS pictures flickered on and off at different frequencies, evoking two independent steady-state visual evoked potentials (ssVEP). Applying support vector machines to BOLD responses in ventral visual cortex and MT cortex we found the following results. First, decoding accuracy of both positive-vs-neutral and negative-vs-neutral distractors is above chance level in ventral visual cortex, at 62.6% and 59.4% respectively; positive-vs-neutral decoding accuracy is marginally higher than negative-vs-neutral decoding accuracy (p=0.08). Second, across subjects, decoding accuracy of negative-vs-neutral distractors is negatively correlated with the correctly identified instances of coherent motion (p=0.01), namely, the higher the decoding accuracy the lower the correctly identified instances of coherence motion; decoding accuracy of positive-vs-neutral distractors, however, is not associated with behavioral

performance (p=0.9). Third, in MT cortex, decoding accuracy of positive-vs-neutral and negative-vs-neutral distractors is also above chance level, at 71.2% and 64.5% respectively, with positive-vs-neutral decoding accuracy significantly higher than negative-vs-neutral decoding accuracy (p=0.0004). Fourth, neither the positive-vs-neutral decoding accuracy nor the negative-vs-neutral decoding accuracy in MT cortex was found to be predicting behavioral performance (p>0.05). In summary, these results demonstrate that (1) although positive distractors are better represented in both ventral visual cortex and MT cortex than negative distractors, it is the negative distractors that have a stronger influence on behavior and (2) although MT cortex is the neural substrate underlying the task-relevant visual processing, it is the ventral visual cortex where the processing of negative distractors adversely impacts behavior.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for coming to my poster. If you have further question, please send me an email to dibanboye@ufl.edu.

Abstract ID: 528

Divergent effects of positive and negative cueing on target enhancement and distractor suppression

Poster Presentation - *Topic area: Attention: Distraction, load*

Christine Salahub[1] (christine.salahub@brocku.ca), Stephen Emrich[1]; [1]Brock University, St. Catharines, ON, Canada

During visual search, one can use information about target features, such as color or shape, to guide attention (positive cueing). Attention can also be guided away from irrelevant items through active suppression of distractor features (negative cueing). Although previous studies have observed faster search times following a negative cue, when the task is relatively easy (i.e. smaller set size), negative cues tend to slow responses. It has been suggested that this is due to initial bottom-up attentional capture by the negatively cued feature, followed by its suppression (i.e. 'search and destroy' mechanism). Here, we aimed to better understand the time course of these cueing effects by examining event-related potentials related to target enhancement (N2pc) and distractor suppression (PD). Participants (N = 20) completed a lateralized visual search task wherein they had to find a target line within a colored circle. On each trial, participants were provided with a color cue indicating whether the target would be within the circle of that particular color, not within that color, or an uninformative cue. We found that participants could use positive cues to focus attention on the target item (as indicated by the N2pc) and suppress the distractor

(as indicated by the PD). In contrast, when given a negative cue, participants inappropriately attended to the distractor color, followed by its active suppression. Ability to suppress the negatively cued distractor was related to individual differences in anxiety. These results provide electrophysiological evidence of the 'search and destroy' mechanism of negative search templates, and suggest that the ability to use negative cue information to benefit performance differs across individuals.

Acknowledgements: NSERC grants #435945 and #458707 awarded to S.M.E

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Welcome to my presentation page!

I will be available to answer your questions asynchronously throughout the conference, as well as during the scheduled Zoom meeting. If you would like to reach me after the conference, please e-mail me at: christine.salahub@brocku.ca.

Abstract ID: 782

Does serial processing of words and faces happen in parallel?

Poster Presentation - *Topic area: Attention: Distraction, load*

Samantha C. Lee[1] (samanthalee@nevada.unr.edu), Matthew T. Harrison[1], Lars Strother[1]; [1]University of Nevada, Reno

Visual word recognition and face recognition are associated with neural mechanisms in opposite hemispheres and opposite visual field advantages. Here we tested whether simultaneously viewed words and faces can be recognized in parallel or not. If so, this would suggest that visual recognition of multiple visual objects belonging to two different stimulus classes are not subject to the same bottleneck as two objects belonging to the same stimulus class (i.e., serial processing of words and faces can happen in parallel). If not, then only one visual object can be processed at a time, implying that the two types of object recognition draw upon shared neural resources. In our study, observers viewed pairs of either words or faces, or a combination of the two. Items in each pair appeared to the right or left of fixation and were either matched (word+word or face+face) or mixed (face+word or word+face) by stimulus class. In doing so, we partially replicated a previously reported finding that visual word recognition is serial (White, Palmer & Boynton, 2018), and we extended this finding to face recognition. A slight recognition advantage was observed in the mixed condition relative to the matched. Results were otherwise largely similar between

mixed and matched stimulus pairings, with the expected opposite visual field advantages occurring for both mixed and matched conditions. In an additional condition, observers were pre-cued to either the right or left stimulus location. This allowed us to show that the benefit of mixing words and faces was small relative to the benefit of cueing. Our results suggest that, despite hemispheric dissociations between word recognition and face recognition, serial processing of words and faces does not occur in parallel because shared visual processing resources are involved.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for stopping by our poster! I am more than happy to answer any questions, my email is samanthalee@nevada.unr.edu.

Abstract ID: 1571

Heads-up! Irrelevant visual information impacts search processes

Poster Presentation - *Topic area: Attention: Distraction, load*

Joanna Lewis[1], Mark Neider[2]; [1]University of Northern Colorado, [2]University of Central Florida

Secondary information presented during a primary task has been repeatedly demonstrated to impair primary task performance. These distraction impairments may be a result of decrements to foveated visual attention, as reflected by failures to detect changes at fixation or recall of fixated objects (McCarley et al., 2004; Strayer et al., 2007). Previous research characterizing distracted visual processing has typically utilized complex and applied scenarios, which directs participants to prioritize their fixations to the center of the display/environment as opposed to the general visual field (e.g., Strayer & Drews, 2007). In four experiments, we aimed to evaluate changes in oculomotor behavior associated with the presence of secondary task information under controlled conditions. The primary task was a visual search task for an oriented target T among distractors Ls (50 & 80 objects); the secondary task was an irrelevant word presented on a heads-up display for 2000ms (compared to search without a secondary task). Participants were instructed that the secondary visual presentation was irrelevant to the search task. The experimental manipulations were overall distraction, masked onset of secondary information, primary information was spatially separated from secondary information, and modality of secondary information (auditory/visual). Overall, we replicated previous studies reporting a cost when search occurred concurrently with a secondary display (Lewis & Neider 2019). These costs were associated with increased fixation durations and initial saccade latencies. No differences occurred in the number of fixations, target verification times, and spatial distribution of fixations (i.e., a contrast to more applied research in the driving domain). The results

indicated that secondary task distraction in visual search induces impairments in deployment of attentional processing at fixation, as opposed to an interference in fixated target perception or the constriction of gaze typically associated with applied contexts.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1702

How many pleasures can you track?

Poster Presentation - *Topic area: Attention: Distraction, load*

Denis Pelli[1,2] (denis.pelli@nyu.edu), Aenne Brielmann[1]; [1]Psychology Dept, New York University, [2]Center for Neural Science, New York University

Choosing often demands that we assess the pleasures of multiple objects at once. Last year at VSS, we showed that people can keep track of at least two pleasures independently. Here, we push this limit and ask whether they can track four. Participants (N = 18) viewed 36 OASIS images that uniformly span the entire range of pleasure (from very unpleasant to very pleasant). On each trial, the observer saw four images in four quadrants of the screen simultaneously for 200 ms. A cue (randomly pointing to one of the four quadrants) indicated which image (the target) the observer should report the pleasure of, while ignoring the others (distractors). In half the blocks, the cue came before the images, and in the other half it came after. At the end of the experiment, we obtain baseline pleasure ratings for images shown one at a time. We model the pre- and post-cued pleasure report as a weighted average of baseline target and distractor pleasures. We used the average root-mean-square error from leave-one-out cross-validation to assess model fit. A model with a target weight of 1.0 fit our data best (mean RMSE = 1.24) compared to a linear model with free weights (RMSE=2.21), as well as a model taking into account the relative pleasure ranking of the images (RMSE=1.61). This was true for both pre- and post-cued trials. Thus, people are able to track at least four pleasures at a time.

Acknowledgements: Supported by NIH grant R01 EY027964 to DGP

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

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Abstract ID: 1756

Split foci of attention in middle childhood

Poster Presentation - *Topic area: Attention: Distraction, load*

Tashauna Blankenship[1] (shaunalb@bu.edu), Roger Strong[2], Melissa Kibbe[3]; [1]Boston University, [2]Boston University, [3]Harvard University

Adults can deploy attention to two locations without allocating it to the intervening space, consistent with multiple foci of attention (Awh & Pashler, 2000). Although children can track multiple objects simultaneously (Blankenship, Strong, & Kibbe, 2018), it is unknown whether children accomplish this by splitting their attention across noncontiguous locations, or instead by diffusely spreading their attention. We tested 25 6-8-year-old children (M=7.30, SD=.95) using a task where attended items were separated by a distractor (similar to Awh and Pashler, 2000). On each trial, children viewed 6 masks (750 ms), two of which were cued (750 ms); the cued masks were always separated by one uncued mask. The masks were then replaced by an array of characters (250 ms), two of which were numbers. The characters were then masked again (100 ms), and then one of the masks was probed. Children had to report the number that had appeared at the probed location. On 80% of trials, one of the two cued locations was probed (valid trials). On the other 20% of trials, an uncued location was probed (invalid trials). For invalid trials, the probed location was either positioned between the two cued locations or outside of the cued locations. If children spread their attention diffusely between the two cued locations, rather than splitting their attention, then they should be more likely to correctly identify numbers when invalid probes appeared between cued locations versus outside cued locations. Children performed better on valid versus invalid trials ($F(2,48)=42.38$, $p<.001$; $\eta p2=.64$), suggesting that they indeed deployed attention to the two cued locations. For invalid trials, however, there was no difference in performance for probes appearing between the cued locations versus outside the cued locations ($p=.41$). These findings suggest that the ability to split attention to noncontiguous locations is present by middle childhood.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 838

The Costly Influence of Task-Irrelevant Semantic Information on Attentional Allocation

Poster Presentation - *Topic area: Attention: Distraction, load*

Ellie Robbins[1] (erobbins105@gwu.edu), Joe Nah[2], Dick Dubbelde[1], Sarah Shomstein[1]; [1]The George Washington University, [2]University of California, Davis

High-level features of objects, such as semantic information, have been shown to bias attention, even when task-irrelevant. However, it remains unclear the exact mechanism by which this attentional guidance is instantiated. We hypothesized that task-irrelevant semantic information organizes visual input through mechanisms of grouping. Similar to grouping by similarity in low-level features, we predict that semantic information organizes visual input by semantic relatedness. Specifically, when presented with multiple task-irrelevant objects, attention is guided, or prioritized, to a subset of objects that are semantically related, creating a grouping-like effect. In the present studies, participants were presented with an array of 4 or 6 objects. The objects were either colored squares (low-level information only) or grayscale real-world objects (high-level information only). On any given trial half of the objects were related to a single category (e.g., clothing or blue squares) while the other half was chosen randomly from other semantic or color categories, respectively. A target was presented randomly on one of the objects, independent of relatedness, rendering color and semantics task-irrelevant for each experiment. For both colored squares and real-world objects, when each group had equal number of members (grouped by color or by semantic relatedness), target identification was faster and more accurate when targets were presented on the color- or semantically-related objects. Interestingly, when the size of the related group increased (e.g., three related objects and one non related object in set size four) performance was slower for targets presented on the objects that shared membership in the larger group versus objects in the smaller group. Taken together, these results support the semantic grouping hypothesis such that semantic information, just as color, organizes visual input to enable efficient attentional allocation. Importantly, given task-irrelevant nature of semantic information, our results suggest that task-irrelevant semantic grouping is an automatic process.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1525

To the edge of gaze and beyond: Visual distraction outside the oculomotor range

Poster Presentation - *Topic area: Attention: Distraction, load*

Nina M. Hanning[1] (hanning.nina@gmail.com), Heiner Deubel[1]; [1]Ludwig-Maximilians-Universität München

Neurophysiological studies demonstrated that attentional orienting is performed by fronto-parietal brain areas which also play an important role in oculomotor control (e.g. LIP, FEF). Accordingly, several studies claimed that exogenous attention can only be allocated to where we can potentially make an eye movement, i.e. within the oculomotor range. We tested this assumption by assessing the disruptive effect of a salient distractor at locations within and beyond participants' oculomotor range. Participants rotated their heads ~38° leftwards to prevent them from performing large rightward saccades. The required head rotation angle was determined individually prior to the experiment and monitored with an electromagnetic motion tracking device. In this posture, participants fixated the screen center and focused their attention on a location on the left side of the screen, where they had to discriminate the orientation of a visual noise patch. While assessing visual orientation sensitivity – an established proxy of visual attention – at this endogenously attended location, we flashed a salient cue either at the attended location or at various locations inside or outside their oculomotor range. We found that whenever the salient cue occurred at a location other than the endogenously attended location, it withdrew visual attention and significantly hampered endogenous attentional orienting. Crucially, this disruptive effect occurred regardless of whether the cue was presented within or beyond participants' oculomotor range, demonstrating that exogenous events equally grab our attention both inside and outside the oculomotor range. Since spatial exogenous attention was attracted unrestrictedly toward locations to which no saccade could be executed, the coupling of attention and eye movement control presumably is less tight than, for example, the prominent "Premotor Theory of Attention" would suggest. Rather, attention can be shifted freely over the entire visual range, independent of pathological and physiological limitations of the eye movement system.

Acknowledgements: This work was supported by grants of the Deutsche Forschungsgemeinschaft (DFG) to HD (GI964/1-1 and DE336/5-1).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 1:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1490

Young drivers' eye movements and driving performance in the presence of a ringing cell phone

Poster Presentation - *Topic area: Attention: Distraction, load*

Kayla Sansevere[1,2] (ksansevere@arcadia.edu), Elizabeth Walshe[2,3], Katherine Moore[1], Chelsea Ward McIntosh[2], Flaura Winston[2,4]; [1]Department of Psychology at Arcadia University, [2]Center for Injury Research and Prevention at the Childrens Hospital of Philadelphia, [3]Annenberg Public Policy Center at the University of Pennsylvania, [4]Perelman School of Medicine at the University of Pennsylvania

Motor vehicle crashes (MVC) are the leading cause of injury and death among adolescents and young adults (National Center for Statistics and Analysis, 2019). Driving while distracted, such as using a cell phone, increases the likelihood of a MVC (National Center for Statistics and Analysis, 2019). People who physically interact with a cell phone while driving (e.g., engaging in a phone conversation, typing out a text message) can adequately sample the surrounding environment, but they are unable to direct and maintain sufficient visual attention to potentially hazardous events (Balk, Moore, Spearman, Steele, & Duckowski, 2006). As a result, engaging in a phone conversation or typing out a text message leads to poor driving performance (Caird, Johnston, Willness, Asbridge, & Steel, 2014; Caird, Simmons, Wiley, Johnston, & Horrey, 2018). But how do cell phones affect eye behavior and driving performance when the driver is not physically interacting with the phone, such as while it is ringing? In an ecologically valid driving simulation, young drivers proceeded through an intersection with and without the presence of a visible ringing cell phone. The median number of glances taken away from the forward roadway in the presence of a ringing cell phone was greater than in the absence of a ringing cell phone. Participants also took longer to drive through the intersection in the presence of a ringing cell phone. We further examined participants' longest glance away from the forward roadway (LGOR), the moderating role of executive function capacity on LGOR, and speed variables. Altogether, our results suggest that even in the absence of physical interaction, cell phones can encourage visual inattention away from the forward roadway which can lead to poor driving performance.

Acknowledgements: This material is based upon work supported by the National Science Foundation under Grant Number EEC-1460927.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 107

Attention: Emotion, reward

Are you attending to me? The effect of social presence on social attention

Poster Presentation - *Topic area: Attention: Emotion, reward*

Dana A. Hayward[1] (dana.hayward@ualberta.ca), Jingru Ha[1], Raman Dhaliwal[1]; [1]University of Alberta

Prior research has demonstrated that the presence of another person can modulate attention. For example, when participants are asked to complete a task in pairs, not only do participants show slower responses when they respond for the second time to the same target location (known as inhibition of return - IOR), but they also show slower responses to a target location that their partner just responded to. This so-called ‘social inhibition of return’ suggests that, at some level, we attend to the behaviours of another, which in turn modulates our responses. However, we wanted to know whether the allocation of attention towards a partner would change if, instead of attending to simple peripheral abrupt onsets, the pairs attended to a social gaze cue. Further, prior work has not manipulated the extent to which partners know each other before completing the task. Thus, in the current study we used a typical gaze cueing task, whereby pairs of participants saw faces looking left or right, and each participant was assigned to respond to either a target “T” or an “L” as soon as it appeared in the periphery. Familiarity was manipulated through asking participants to either complete a short semi-scripted conversation before beginning the computer task (Acquaintances; n=54) or afterwards (Strangers; n=52). Repeated-measures ANOVAs revealed different patterns of attention across the two groups. The Acquaintance group revealed an effect of previous responder, with robust social attention only when responding after oneself. In contrast, the Stranger group revealed a 3-way interaction; inhibition occurred during opposite-responder trials to the same spatial location, and facilitation was strongest during same-responder trials to the opposite spatial location. Together, our results indicate that social attention can be modulated based on a partner’s response, and furthermore that partner familiarity plays an important role in this attentional modulation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1218

Arousal-Biased Competition Explains Reduced Distraction by Reward Cues Under Threat

Poster Presentation - *Topic area: Attention: Emotion, reward*

Andy J. Kim[1] (jskim628@tamu.edu), Brian A. Anderson[1]; [1]Texas A&M University

Anxiety has consistently been found to potentiate the attentional processing of physically salient stimuli. However, a recent study demonstrated that experimentally-inducing anxiety reduces attentional capture by previously reward-associated stimuli, suggesting that anxiety does not globally increase distractibility but rather its influence depends on the nature of the eliciting stimulus. To decipher how the processing of threat interacts with the processing of visual reward cues, we probed the neural mechanisms of oculomotor capture by previously reward-associated stimuli with and without the threat of unpredictable electric shock (blockwise manipulation, within-subjects), combining the value-driven attentional capture paradigm with the translational threat of shock paradigm in an fMRI study. Our eye-movement data replicated prior behavioral findings demonstrating an interaction between threat and distractor condition, with oculomotor capture by previously reward-associated distractors being reduced under threat. In our neuroimaging data, significant main effects of threat and distractor condition on stimulus-evoked blood-oxygen-level-dependent (BOLD) activation were evident in the extrastriate visual cortex, frontal eye field, intraparietal sulcus, and caudate tail, collectively referred to as the value-driven attention network (VDAN). In addition, we found an interaction between distractor condition and threat within each region of the VDAN. Surprisingly, the direction of this interaction was opposite that of the behavioral interaction, with the previously reward-associated distractor evoking especially strong neural activation under threat. Our neuroimaging data are consistent with the Arousal-Biased Competition (ABC) model of information processing in the visual system, although our corresponding behavioral results suggest that, at least under certain circumstances involving reward cues, such biased competition can be leveraged to facilitate more efficient ignoring at the level of eye movements. Our findings inform our understanding of value-driven attention, emotion-attention interactions, and mechanisms of signal suppression.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for taking the time to visit my poster! I will be available for live chat via Zoom on June 23rd. Also, feel free to ask me any questions by email at anytime.

Andy J. Kim

Abstract ID: 169

Attentional capture with emotional cues remains intact in amblyopia

Poster Presentation - *Topic area: Attention: Emotion, reward*

Amy Chow[1] (ahychow@uwaterloo.ca), Yiwei Quan[1], Celine Chui[1], Roxane Itier[1], Benjamin Thompson[1]; [1]University of Waterloo

Introduction: Amblyopia is a neurodevelopmental disorder of vision that has been associated with visual attention deficits. We investigated whether attentional capture by fearful facial expressions was affected by amblyopia. Methods: Participants (n = 30 controls; 10 amblyopia) completed a cued peripheral target (0.9 deg x 0.9 deg) detection task. The cue was a centrally presented face with left or right gaze. The face adopted a fearful, happy or neutral expression for 500 ms. The target was then presented in a location either congruent or incongruent to the face's direction of gaze. Participants indicated target location (left/right) and reaction times were measured. Central fixation was ensured using an eye tracker. Gaze cueing for each emotional expression was computed as the difference in reaction time between congruent and incongruent trials. 128 trials were performed for each facial expression across 3 viewing conditions in a randomized order: monocular non-dominant/amblyopic eye (NDE), monocular dominant eye (DE), and binocular (BE). Participants also rated the valence and intensity of each facial expression, viewing with the non-dominant eye. Results: Ratings for the facial expressions were not affected by amblyopia. Reaction times for the non-dominant/amblyopic eye were analyzed with a 3 (Emotion: fear, neutral, happy) x 2 (Congruency: congruent, incongruent) x 2 (Group: control, amblyopia) ANOVA. Consistent with previous work, there was a significant interaction between Emotion and Congruency, characterized by a stronger gaze cueing effect for fearful versus neutral and happy expressions. There was no effect of Group. Post-hoc analysis revealed that the significant interaction between Emotion and Congruency was present for both groups independently. The expected interaction between Emotion and Congruency was also present in the other two viewing conditions. Conclusion: Although spatial attention deficits are associated with amblyopia, attentional capture with emotional cues appears to remain intact.

Acknowledgements: NSERC

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

23 June, 3:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 435

Concurrent Physical Effort Increases Attentional Capture by Salient-but-irrelevant Color Singleton

Poster Presentation - *Topic area: Attention: Emotion, reward*

Shinhae Ahn[1] (shinhaeahn.sinai@gmail.com), Hyung-Bum Park[1], Weiwei Zhang[1]; [1]University of California, Riverside

The present study examined the impacts of effortful physical action on ongoing mental processes, specifically the efficiency of inhibiting perceptually salient but task-irrelevant distractor. To this end, we conducted a dual-task experiment with concurrent visual search task and handgrip task. In the search task, a target shape (square) appeared among nine homogeneous distractor shapes (circles) on an imaginary circle. Participants reported whether the direction of an orientation bar inside the target shape was vertical or horizontal as quickly and accurately as possible using a right-hand button press. Critically, one of the homogeneous distractors was presented in a different and salient color that was irrelevant for the task (color singleton present) on half of the trials, but not the other half of trials (color singleton absent). In the concurrent handgrip task, the participants squeezed a hand dynamometer, using left hand, to 5% or 40% of their individual maximum voluntary force (MVC) measured at the beginning of the study. The handgrip condition (5% versus 40%) and the color singleton condition (present versus absent) were randomly mixed across trials. Our results suggested that the singleton distractor effect, measured by the reaction time (RT) cost between the singleton present and absent conditions, increased from the low physical load to the high physical load condition. Furthermore, this detrimental effect of physical load significantly correlated with the extent of instability during force maintenance as well as the exerted force across the participants. Taken together, these results provide strong support that effortful physical action reduced inhibitory control of ongoing mental processes.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

All of the feedback is welcome! If any further questions, please feel free to contact me (shinhaeahn.sinai@gmail.com)
** I am going to apply for a Ph.D. program in Cognitive Psychology for Fall-2021. My research interests also encompass selective attention mechanisms such as facilitation and inhibition as well as visual working memory.

Abstract ID: 1673

Emotion Induced Blindness in the Left and Right Visual Field

Poster Presentation - *Topic area: Attention: Emotion, reward*

Ella Moeck[1] (ella.moeck@monash.edu), Nicole Thomas[1], Steven Most[3], Jenna Zhao[3], Melanie Takarangi[2]; [1]Monash University, [2]Flinders University, [3]University of New South Wales

It is often crucial to attend to relevant, and ignore irrelevant, visual information. But when irrelevant information is emotional, it reflexively captures attention, impairing noticing of neutral targets appearing directly afterwards. This robust effect is known as emotion induced blindness. We tested whether emotion induced blindness is exacerbated in the left compared to the right visual field. This hypothesis stems from neurotypical people paying slightly more attention to the left than the right side, which can increase susceptibility to left-side distraction. On each trial, two simultaneous rapid streams of images (100-ms/image) appeared, one to each visual field. Participants reported the clockwise/counterclockwise orientation of a neutral target image embedded in one of the streams. Two items before the target (i.e., lag 2), a neutral or negative emotional distractor could appear. The distractor and target could appear in the same stream, or the opposite stream, as each other. On trials with neutral distractors (and no distractors), target detection was approximately 6% higher in the left than the right visual field. On trials with emotional distractors, however, target detection was impaired to the same degree in the left as the right visual field. We replicated these findings in a second experiment. Taken together, these findings suggest that when emotional distractors are present, they disrupt perception, regardless of distractor and target location. Future research should investigate the time course of this emotional disruption in the left and right visual fields, by manipulating the number of items between the distractor and target (e.g., comparing lag 2 with lag 7). This work has important implications for understanding how to reduce emotional distraction in sustained attention tasks, where distraction can be fatal (e.g., driving).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
24 June, 1:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1660

Emotional stimuli exert surprisingly weak capture of temporal attention

Poster Presentation - *Topic area: Attention: Emotion, reward*

Lindsay A. Santacroce[1] (lindsayas22@gmail.com), Apurva L. Swami[1], Benjamin J. Tamber-Rosenau[1];
[1]University of Houston

Emotional distractors are thought to capture both temporal and visuospatial attention in spite of top-down goals. In the emotional attentional blink or emotion-induced blindness (EIB) phenomenon, an emotional but task-irrelevant critical distractor item (CDI) captures attention away from a target embedded in a rapid serial visual presentation (RSVP) stream. As a result, participants frequently miss the target if it is presented shortly after the CDI, similar to how participants miss the second of two targets in the standard attentional blink (AB). However, a recent study presented at VSS (Santacroce, Petro, Walker, & Tamber-Rosenau, 2019) combined the EIB and AB within single, hybrid trials by presenting CDIs interposed between two targets and showed that CDIs failed to break through the two-target AB unless they were highly visually distinct from other RSVP items. This recent result indirectly challenged previous assumptions about the ability of emotional stimuli to capture attention, motivating a more direct test of the strength of emotional capture of temporal attention. Here, we report two new experiments in which we directly compared EIB and two-target AB trials in the same participants in order to assess the relative strength of attentional capture by emotional stimuli compared to top-down targets in the AB. In each experiment, participants viewed RSVP streams of images with randomly intermixed two-target AB and CDI-plus-target EIB trials. Targets in Experiment 1 were defined by a border color, which requires only perceptual processing of distractor borders, but has previously been used to indicate targets in EIB studies. Targets in Experiment 2 were defined as images of fruit in a stream of objects, requiring semantic processing of each RSVP image. Both experiments revealed a strong AB, but failed to yield a strong EIB. These results suggest that emotional stimuli may not capture temporal attention as strongly as previously thought.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

If you can't make my scheduled presenter conference times, but would still like to meet, feel free to email me at lsantacroce@uh.edu

Abstract ID: 1256

Impacts of Relative and Absolute Values on Selective Attention

Poster Presentation - *Topic area: Attention: Emotion, reward*

Sunghyun Kim[1], Melissa Beck[1]; [1]Louisiana State University

Valuable stimuli receive attentional priority. However, it is unknown whether the mechanism of the attentional priority is based on relative (e.g., higher or lower than the value of another available object) or absolute value (e.g., 45 points) because high valued stimuli were relatively and absolutely valuable more than low valued stimuli in previous research. To investigate the impacts of the relative and absolute values on selective attention, we manipulated the relative and absolute values independently in a modified value-driven attention capture paradigm. In the training phase, reward was presented during a visual search task to aid associative learning between color and reward value, two test target colors were each presented with another different target color (reference target colors) in separate context blocks. Therefore, each test target color had different reference points. In the test phase, the two test target colors were presented as singleton distractor colors during a shape singleton search task. In Experiment 1, the absolute value of the reward associated with the two test target colors was the same, but one had a relatively higher value compared to its reference target color and the other had a relatively lower value. The relatively higher-valued color singleton distractor captured attention more than the relatively lower in test phase, suggesting that the relative value of stimuli influenced selective attention. In Experiment 2 the relative value of the test target colors was the same, but the absolute value was higher for one. The higher and lower absolute valued color singleton distractors captured attention equally, indicating little impact of the absolute value on attention. The present study suggests that the relative rather than absolute value plays a critical role in attention allocation, and that prospect theory (Kahneman & Tversky, 1979) may extend to earlier cognitive stages such as selective attention.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 192

Neural Correlates of Value-Driven Spatial Attention

Poster Presentation - *Topic area: Attention: Emotion, reward*

Ming-Ray Liao[1] (m4liao@tamu.edu), Jeesu Kim[1], Brian Anderson[1]; [1]Texas A&M University

Reward learning has been shown to guide spatial attention to regions of a scene. However, the neural mechanisms that support this bias in spatial orienting is unknown. We adapted an established paradigm for fMRI to identify neural correlates of reward-modulated spatial orienting. From reward feedback, participants learned to orient to a particular quadrant of a scene (high-value quadrant) to maximize gains. This learning was scene-specific, with the high-value quadrant varying across different scenes. During a subsequent test phase, participants were faster at identifying a target if it appeared in the high-value quadrant (valid). On participants we collected eye data for, the first saccades were also more likely to be in the high-value quadrant. fMRI analyses during the test phase revealed learning-dependent priority signals in the bilateral caudate tail and superior colliculus. In addition, scene selective and spatial processing regions (hippocampus, parahippocampal place area, and temporo-occipital cortex) were more strongly activated on valid compared to invalid trials. Other regions that were preferentially activated on valid trials include the frontal eye field, substantia nigra, and insula. Taken together, our results suggest regions that process scenes and space play a role in value-driven attention, extending principles of value-driven attentional priority to such representations. The caudate tail has been frequently linked to value-driven attentional capture by feature-defined stimuli, and here we extend its role to spatial orienting, suggesting a more general role in the value-driven control of attention. Consistent with an automatic and reflexive influence of learning on spatial orienting, the superior colliculus was robustly modulated by spatially-specific scene-reward associations, which given its rich connections with the caudate tail and ventral visual stream may form an integrated network for the value-dependent control of spatial attention. Subsequent analyses will focus on cerebellar contributions to value-driven orienting as well as decoding scene-specific representations from scene-selective activations.

Acknowledgements: This research was supported by the National Institutes of Health (R01-DA046410) and the Brain and Behavior Research Foundation (NARSAD grant 26008)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 318

Quantifying electrophysiological responses in a covert orienting task designed for eye tracking

Poster Presentation - *Topic area: Attention: Emotion, reward*

Charisse B. Pickron[1,2] (cpickron@umn.edu), Neely C. Miller[2], Jed T. Elison[1,2]; [1]Institute of Child Development, University of Minnesota, [2]Center for Neurobehavioral Development, University of Minnesota

We explored whether attentional biases, elicited with an eye-tracking based attentional cueing paradigm, could be similarly interrogated with concurrent recording of time-locked electrophysiological responses. Twenty-nine adult participants completed a cueing paradigm while eye movement (not reported here) and event-related potentials were recorded. Stimuli included images of faces with fearful, neutral, and happy expressions. Participants first fixated on a central crosshair for a variable duration. Then a pair of faces (i.e., competing cues) was presented within the extrafoveal visual field for 24 ms. The paired faces expressed either the same (i.e., fearful vs. fearful) or different (i.e., fearful vs. neutral) emotions. Cue faces were followed by backward masks presented for 126 ms. Lastly, a single face (i.e., target) appeared laterally, with a happy expression for 1000 ms. Preliminary results included data from 14 participants (15-20 will be added before the meeting). In response to cue faces, we found a positive peak 90 milliseconds after onset (i.e., P100) and a negative peak 130 milliseconds following onset (i.e., N170) in left and right parietal-occipital scalp regions. In response to the target face we found early occurring positive and negative peaked components in the frontal and parietal regions potentially indicative of oculomotor planning. These components occurred approximately 50 milliseconds prior to saccadic eye movement identified in the waveform. Additionally, we found evidence of a later occurring negative component approximately 150 milliseconds following target onset (i.e., N170 component) in parietal-occipital regions. We observed canonical electrophysiological correlates indicative of early visual perception in a covert orienting task designed to restrict the amount of visual information reaching visual cortex. Next steps include assessing possible amplitude and latency differences based upon cue and target face location congruency. These analyses will help characterize neurophysiological correlates of attention bias to threat.

Acknowledgements: This study was supported by the President's Postdoctoral Fellowship funding awarded to C. Pickron. Technical & resource support received from the Center for Neurobehavioral Development, University of Minnesota

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1498

Threat-modulated attentional priority is context specific

Poster Presentation - *Topic area: Attention: Emotion, reward*

Laurent Grégoire[1] (lgregoire1@tamu.edu), Haena Kim[1], Andy J. Kim[1], Brian A. Anderson[1]; [1]Texas A&M University

Attention prioritizes stimuli previously associated with punishment. Despite the importance of this process for survival and adaptation (e.g., detect threatening stimuli), the potential generalization of threat-related attentional biases has been largely ignored in the literature. The present study aimed to determine whether stimulus-threat associations learned in a specific context transferred to another context (in which the stimulus was never paired with punishment). We examined this issue using an antisaccade task in which participants had to shift their gaze in the opposite direction of a colored square. Two contexts and three colors were employed. One color was associated with the threat of shock in one context (slow and inaccurate eye movements resulted in shock) and never paired with shock in the other context. For a second color, the punishment-context relationship was reversed. The third color was never paired with shock in either context (neutral). Context was manipulated via the background image upon which the stimuli were presented, as in a previous study demonstrating contextual specificity of reward-related attentional bias. Results indicated that error rates were significantly greater when the color was associated with punishment in the current context relative to the other two conditions. In a subsequent extinction phase (in which no shock was delivered) involving search for a shape-defined target, a bias to orient toward shock-associated colors was particular to the context in which the color was associated with shock, suggesting a contextually-specific attentional bias driven by associative learning. However, in the extinction phase, the color previously associated with punishment in context did not affect performance relative to the neutral condition; this absence of effect could be due, at least partially, to the fact that the neutral color was processed as a safety signal by some participants. Overall, results suggest that threat-modulated attentional priority is context specific.

Acknowledgements: This study was supported by grants from the Brain & Behavior Research Foundation [NARSAD 26008] and NIH [R01-DA046410] to Brian A. Anderson.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please, do not hesitate to contact me (by chat) if you have any questions.
We can also plan a Zoom meeting if you have a lot of questions (or recurrent questions).

Abstract ID: 220

Attention: Features, objects, locations

A unified account of repetition blindness and the attentional blink

Poster Presentation - *Topic area: Attention: Features, objects, locations*

David Huber[1] (dehuber@umass.edu), Lucas Huszar[2]; [1]University of Massachusetts, Amherst, [2]New York University

The perceptual wink model of the Attentional Blink (AB) assumes that the AB is a perceptual deficit, reflecting a failure to perceive that the second target belongs to the target category. Providing a unified account of the AB and Repetition Blindness (RB), we augmented the perceptual wink model with a Bayesian decision process that compares the observed evidence in short-term memory against evidence priors to determine how many times a particular identity appeared. This unified explanation of the AB and RB does not require type-token binding; in lieu of tokenization, performance is based on the magnitude of evidence for each type. Chun (1997) examined RB in a letter-number attentional blink AB task, finding that some manipulations selectively reduced the AB while others selectively reduced the RB. The perceptual wink model is a dynamic neural network with perceptual habituation, and explained these dissociations as reflecting perceptual habituation for a character's appearance/identity (i.e., which letter or number?) in the case of the RB versus perceptual habituation for alphanumeric category (i.e., is it a number or a letter?) in the case of the AB. We assessed the unified model with Chun's AB/RB paradigm by manipulating the category mapping; one group of subjects received consistent mapping, with a set of characters consistently assigned to the target category (e.g., always letters or always numbers), while another group received varied mapping, with variation across trials for the target category (e.g., letters on some trials and numbers on other trials). As predicted, the category mapping manipulation affected RB and the AB in a similar manner. Multiple-choice testing confirmed the prediction that in the midst of both the AB and RB, participants would claim that the trial only contained one target, as expected from a failure to perceive that the second target belonged to the target category.

Acknowledgements: This research was supported by NIMH RF1MH114277 and NSF BCS-1431147.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

e-mail: dehuber@umass.edu

Abstract ID: 1415

Attentional modulation of feature-selective priority maps across human visual cortices

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Daniel Thayer[1] (danielthayer@ucsb.edu), Tommy Sprague[1]; [1]University of California, Santa Barbara

Different parts of the visual system respond strongly to particular visual features, such as color (hV4/VO1; Engel et al, 1997; Brewer et al, 2005) or motion (hMT+/TO1/TO2; Tootell et al, 1995; Amano et al, 2009). Computational theories posit that attention is guided by a combination of spatial maps for individual features that are weighted according to task goals (Itti & Koch, 2001; Serences & Yantis, 2006). Consistent with this framework, when a stimulus contains several features, attending to one or another feature results in stronger fMRI responses in regions preferring the attended feature (Beauchamp et al, 1997; McMains et al, 2007; Runeson et al, 2013). We hypothesized that multivariate activation patterns across these feature-responsive regions form spatial 'feature maps', which combine to guide attentional priority. One prediction from this hypothesis is that changes to task demands will reweight the spatial representation of objects in the scene within neural priority maps according to the correspondence between the stimulus features, the attended feature, and a region's preferred visual feature. We tested this prediction by reconstructing spatial priority maps from fMRI activation patterns across retinotopic regions of visual cortex using a 2D spatial inverted encoding model (Sprague & Serences, 2013). Participants viewed a peripheral visual stimulus at a random location on each trial which always contained both visual motion (clockwise/counterclockwise) and color (blue/red). On each trial, participants were precued to report the predominant direction of motion or color of the stimulus. Consistent with previous univariate results, stimulus representations in reconstructed priority maps were selectively enhanced in color-responsive regions when color was attended, and in motion-responsive regions when motion was attended. These results suggest different cortical regions support spatial maps of different visual features, and that these maps can be reweighted based on task demands to guide visual behavior.

Acknowledgements: Sloan Research Fellowship (TCS) & Nvidia Hardware Grant (TCS)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1604

Cue reliability modulates interdependency between space- and feature-based attention during perceptual decision-making

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Guangsheng Liang[1] (guangsheng.liang@ttu.edu), Miranda Scolari[1]; [1]Texas Tech University

Selected visual information receives preferential processing when top-down attention is applied to sensory input. Multiple selection mechanisms can be deployed simultaneously, but the extent to which the unique influences of each combine to facilitate behavior remains unclear. We utilized an integrated pe-cue containing both location and color information that reliably predicted a target in a sparse display to investigate possible interactions between space-based (SBA) and feature-based (FBA) attention effects. Previously, we observed little additive perceptual benefit when both were cued simultaneously in a sparse display. The contribution from FBA was restricted to non-perceptual decision-making processes where it depended on the presence of SBA, while SBA influences additionally facilitated target enhancement (Liang & Scolari, VSS 2018). Here, we examined whether differences in the reliability of each pre-cue component modulates the presence and magnitude of attention effects and their interactions across perceptual decision-making processes. Across two experiments, we independently manipulated the proportion of trial-by-trial pre-cues that contained valid space and/or feature information. Regardless, SBA and FBA effects in accuracy were additive, indicative of independent mechanisms within target enhancement, consistent with previous work. Estimated drift rates produced by a simple drift diffusion model exhibited a similar pattern, such that the speed with which target information was accumulated in response to one dimension of the cue did not depend on the other. However, we also observed super-additive relationships between SBA and FBA within other decision-making components, again replicating our previous findings, and these depended on cue reliability. Non-decision time (proportion of RT outside of evidence accumulation) was reduced and responses were more conservative for the most likely pre-cue combination—even in scenarios where the most likely combination included an invalid component. These data indicate a higher-order dependency between selection mechanisms outside of signal enhancement, where decision-making processes may track cue reliability.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1207

Disentangling shift direction, object orientation, and object selection yields a large, reliable metric of object-based attention

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Adam Barnas[1] (ajbarnas@uwm.edu), Adam Greenberg[2]; [1]Department of Psychology, University of Wisconsin-Milwaukee, [2]Department of Biomedical Engineering, Medical College of Wisconsin

Object-based attention (OBA) preferentially enhances visual information within the boundaries of attended versus unattended objects. The double-rectangle cueing paradigm (Egly et al., 1994) typically exhibits enhanced performance to targets at a same-object versus different-object location (~13ms), termed the "same-object advantage". Mounting evidence suggests this effect is inconsistent and small in magnitude: several studies have failed to show a same-object advantage or have even found a same-object cost. Moreover, Pilz and colleagues (2012) demonstrated that these effects vary by object orientation, with few participants (15%) exhibiting significant effects. This inconsistency ultimately encourages questions regarding the legitimacy of OBA. In the double-rectangle cueing paradigm, confounds between shift direction, object orientation, and object selection may drive these inconsistencies. We developed a paradigm that eliminated these confounds by permitting attention shifts across the visual field meridians to be contained within the boundaries of a single 'L'-shaped object. Following a peripheral cue, participants detected a target that appeared at the cued location or at one of two noncued locations equidistant from the cue – the horizontal ("invalid-horizontal") or the vertical ("invalid-vertical") locations. At the group level, RTs were significantly faster at the invalid-horizontal versus invalid-vertical location, resulting in the "shift direction anisotropy" (SDA; ~78ms). Relative to the proportion of individuals who exhibited a same-object advantage reported by Pilz and colleagues (2012), a significantly larger proportion of participants exhibited an SDA (65%). A within-subjects experiment revealed larger and more prevalent effects for the SDA versus the same-object advantage. These findings demonstrate that the confounds described above might have caused past inconsistent OBA results and that the SDA may be a more reliable measure of OBA than the traditional same-object advantage. Thus, stable and large magnitude effects of OBA selection do exist when examined from a perspective that ameliorates confounding factors.

Acknowledgements: US-Israel Binational Science Foundation, University of Wisconsin-Milwaukee Research Growth Initiative, and Greater Milwaukee Foundation

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 881

Feature-based attention induces location transfer in perceptual learning

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Shao-Chin Hung[1] (sch462@nyu.edu), Marisa Carrasco[1]; [1]New York University

[Goal] Perceptual learning (PL), experience-induced improvement in perception, is typically highly specific to the trained location and feature. However, location specificity can be alleviated by particular training protocols. Manipulating exogenous (Donovan, Szpiro & Carrasco, 2015) or endogenous (Donovan & Carrasco, 2018) spatial attention during training facilitates learning transfer more efficiently than other protocols that require a secondary training task. Here we investigated whether feature-based attention (FBA), which enhances the representation of particular features throughout the visual field, facilitates location and/or feature transfer in PL. [Methods] To investigate the effects of FBA on specificity in PL, we implemented an orientation discrimination task in which observers were first presented with two reference angles simultaneously, then asked to discriminate whether the orientation of a Gabor stimulus was clockwise or counter-clockwise to either reference. In Experiment 1, we confirmed that FBA improved accuracy in this task. In Experiment 2, two groups of observers participated in a six-day PL study; the Attention group trained with a feature attention cue, indicating on a trial-by-trial basis which of the two reference angles was relevant for the discrimination, and the Neutral group trained with a neutral cue, indicating both reference angles. Observers were presented with neutral cues during both the pre-test (before training) and post-test (after training) sessions. [Results] For both groups of observers, performance improved for the trained feature at the trained location. Notably, training with FBA enabled complete learning transfer to the untrained location, but not to the untrained orientation. In contrast, the Neutral group exhibited both location and orientation specificity. [Conclusion] Our results show a perceptual benefit of FBA in an orientation discrimination task, and reveal a remarkable spatial-transfer of learning induced by FBA, reminiscent of its global effect across the visual field. This study has possible translational implications for perceptual training in visual rehabilitation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 780

Feature-based attention warps perception of color

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Audrey Barszcz[1], Angus F. Chapman[1], Chaipat Chunharas[2], Viola S. Störmer[1]; [1]Department of Psychology, University of California San Diego, [2]Department of Medicine, King Chulalongkorn Memorial Hospital, Chulalongkorn University, Bangkok, Thailand

Attention to a specific feature (e.g., the color red) enhances processing of that feature over other, unattended features. However, whether and how focusing attention to a specific color may alter feature representations outside the focus of attention is largely unknown. In two experiments, we show that feature-based attention changes the appearance of colors, and that this perceptual warping extends through large parts of the feature space. Participants performed two tasks: First, they continuously attended to a set of colored target dots among distractor dots (30° away along a CIELab color wheel) to detect a brief decrease in luminance of the targets. Simultaneously, they judged which of two briefly, unpredictably flashed probe colors was most similar to the attended target color. Probe colors were sampled from around the color wheel, both on the same side as the distractor color and on the opposite side. We modeled the effects of attention on color similarity judgments using maximum-likelihood difference scaling (Maloney & Yang, 2003). In Experiment 1, participants (N=20) more accurately discriminated colors on the same side of the color wheel as the distractor compared to equally-distant colors on the opposite side, leading to a reliable separation of the similarity functions on each side of the color wheel. In Experiment 2 (N=30), we replicated this finding when probe colors appeared without the target and distractor dots on the screen, eliminating the possibility of color contrast. These findings suggest that feature-based attention can alter color representations, such that colors closer to targets and distractors are perceived with higher fidelity relative than colors more distant in feature space. This demonstrates that attention does not act uniformly on a given feature space, solely enhancing target processing, but can warp feature representations across the feature space, effectively decreasing the similarity between targets and potential distractors.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1304

Many exposures to a real-world object without knowing the details: The focus of attention does not include entire objects but only the relevant level of abstraction

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Michael G Allen[1] (mgallen@ucsd.edu), Timothy F Brady[1]; [1]University of California, San Diego

Participants frequently fail to remember information (e.g., the identity of a letter) immediately after seemingly processing it (finding the letter in a set of numbers to report its color; Chen & Wyble, 2015). This appears to pose a challenge to the common assumption that an item in the focus of attention is processed and therefore remembered a few seconds later. Chen and Wyble argue that the target identity is encoded but not consolidated into memory, however we have recently suggested that there may be a failure of encoding: some category information is so automatically accessible, identity never needs to be accessed or encoded at all. For example, while membership of the category 'letter' may be automatically assessed, membership of category 'letter from 1st half of the alphabet' almost certainly requires processing of identity. Consistent with this, we find that in the latter condition, participants accurately remember letter identity, suggesting that when identity is necessary for target identification it is encoded and consolidated into memory. The current study extends these findings to an investigation of the commonly demonstrated long-term memory-based amnesia for details of the US penny (Nickerson, 1979). On every trial, people searched for and found a penny. When participants looked for this penny target among real coin distractors, they had amnesia for penny details (on two surprise trials), despite having seen it thousands of times previously and having searched for it actively on a dozen proceeding trials. However, when fake pennies were included as distractors, this amnesia disappeared. These results argue that the focus of attention is not all-or-none: we can look at and process a penny or a letter, but we do not by necessity process the entire object when we do so. The information required for report causes different levels of processing of the exact same object.

Acknowledgements: NSF BCS-1829434 to TFB

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1740

Proactive memory-guided attentional templates are flexibly weighted across feature dimensions

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Sage E.P. Boettcher[1], Freek van Ede[1], Anna C. Nobre[1]; [1]Brain and Cognition Lab, University of Oxford

Proactive attentional templates shape our expectations and facilitate perception. Recent evidence has shown that templates are not necessarily veridical, but can be ‘warped’ within a feature dimension to facilitate optimal task performance. It remains unclear if these templates are additionally biased between feature dimensions – and whether templates become similarly biased when retrieved through long-term memory associations. Participants learned association between four shapes and four colored gratings. Gratings each had a unique combination of color (green or pink) and orientation (left or right tilt). On each trial, observers saw a shape followed by a grating and indicated whether or not the pair matched the learned shape-grating association. We manipulated the probability of the lure (non-match) stimuli either block-wise (experiment 1) or within a trial (experiment 2). In experiment 1, in some blocks the lure was most likely to differ from the target in color but not orientation, while in other blocks this was reversed. Participants were more likely to commit false alarms and to respond more slowly to unexpected lures, indicating that the template for the upcoming stimulus had been adapted such that the distinguishing feature dimension dominated the template. In experiment 2, we asked whether the same templates could be flexibly adjusted within a trial. This time, gratings either appeared after a short (1.25 s) or long (2.5 s) delay. If a lure appeared early, it would likely share one specific feature with the target but differ in the other. If a lure appeared late, the opposite was true. Here, observers showed higher false alarms to the unexpected lures from the short time period, irrespective of the time they were probed. The template was thus biased to the initially anticipated diagnostic feature, but this feature weighting was “sticky” and was not dynamically reversed within a trial.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 796

Prolonged Performance in a Multi-Sensory Vigilance Task on a Web-based Survey Hosting Program

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Bridget Wilson[1,2], Chad Peltier[2], Matthew Daley[1,2], Justin Handy[2]; [1]Leidos, [2]Naval Submarine Medical Research Laboratory

Vigilance is the ability to sustain goal-directed attention over long periods of time. Previous research shows the ability to maintain performance may decline during solely visual and solely auditory vigilance tasks, resulting in misidentified stimuli, i.e. the vigilance decrement. However, little research has compared the vigilance decrements in single sensory modality tasks to those that may occur under multimodal conditions, such as audiovisual tasks. To address this knowledge gap, we tracked stimulus identification rate using a modified version of the Integrated Visual and Auditory Continuous Performance Test across three vigilance conditions: visual, auditory, and audiovisual. This task required participants to monitor for a stimulus in the presence of distractors. The task stimuli were modified to be “b” and “p” instead of “1” and “2”, because these letters are difficult to discriminate between in visual and auditory modalities. To prevent ceiling effects on performance, the auditory stimuli were masked with static noise whereas the visual stimuli had shortened tails to appear more similar. The stimulus-to-distractor ratio was set to 1:5.25. Each session included four blocks of 250 trials which took approximately 26 minutes. One hundred subjects were recruited using Amazon MTurk. Differences in stimulus identification rate and reaction time were determined using 3X4 mixed ANOVAs with the between-subjects factor of condition and the within-subjects factor of block. Results indicated a significant interaction between condition and block such that stimulus detection rate significantly decreased in the audiovisual group relative to the other conditions. There were no systematic changes in reaction time, suggesting that the decrease in accuracy was not due to a speed-accuracy trade-off. These results suggest that monitoring multiple modalities of information versus a single modality results in a larger vigilance decrement, and thus may be more cognitively taxing.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 319

Tracking objects in 1/f noise and plain backgrounds

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Filip Děchtěrenko[1] (dechterenko@praha.psu.cas.cz), Jiří Lukavský[1], Christina J. Howard[2]; [1]Czech Academy of Sciences, [2]Nottingham Trent University

Past research has shown that people can reliably track several moving objects among distractors. Although laboratory studies typically use clearly visible objects and a uniform background, this is rarely the case for tracking in real life. Therefore, the contribution of visibility and attentional enhancement of visibility to tracking performance is currently underexplored. In this study we explored performance when tracking 4 Gabor patches amongst 4 distractor patches in 1/f noise (noise tracking) and plain backgrounds (traditional tracking). In the first experiment (n=25), we explored noisetracking performance when object detectability is reduced. Gabor patches were presented at four contrast levels. In the second experiment (n=38), we tested whether any reduction in performance is caused by lower detectability either during tracking or in the response phase after objects have stopped moving. Additionally, we tested how tracking performance in noise correlated with performance in traditional MOT. First, we presented participants with Gabor patches of three different contrast levels based on results from Experiment 1. In half of trials, we highlighted all objects after the motion phase with a red circle, while in the other half, objects were not highlighted. After completing the noise tracking task, participants were tested on traditional tracking with white circles on a uniform gray background (60 trials in total). Tracking performance was impaired with decreases in detectability (both Experiments) and highlighting the targets during the response phase increased performance (Experiment 2). Moreover, performance in noise tracking was highly correlated with performance in traditional tracking ($r > .61$). We report two main findings: First, general tracking performance appears to be partly determined by a combination of detectability both during and after the tracking phase. Second, performance in noise tracking shares individual variability with performance in traditional MOT.

Acknowledgements: This project was supported by Czech Science Foundation grant (GA19-07690S) and RVO68081740.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

I'll happily answer your comments! Reach me on twitter @fdechterenko or via email filip.dechterenko@gmail.com

Abstract ID: 479

Visual predictions from physical relations

Poster Presentation - *Topic area: Attention: Features, objects, locations*

Alon Hafri[1] (ahafri1@jhu.edu), Michael Bonner[1], Chaz Firestone[1]; [1]Johns Hopkins University

Understanding the world around us involves understanding not only which objects are where, but also how they relate—as when we see that one object is on, above, behind, or inside another. Some of these relations are physical, and play a special role in predicting the future state of a scene: If something is inside a cup—rather than occluded by it—we can assume that it will move if the cup moves. But beyond our ability to reason about what different physical relations entail, might they influence visual attention itself? Here, we ask whether the perception of physical relations automatically guides active maintenance of object identities—a core visual process by which the mind computes correspondence between current and previously seen objects. We turned the classic “object reviewing” paradigm into a “cups-and-balls” game in which participants rapidly responded to a target letter. On each trial, two balls with letters dropped into or behind two cups; then, the cups swapped places and disappeared, revealing the balls with letters. Crucially, the balls were equally likely to appear in the same or swapped locations, regardless of the relation (Containment vs. Occlusion). Nevertheless, we observed a “relation congruency” effect: For Containment more than for Occlusion, participants were faster to respond to the letters when they swapped positions along with the cups than when they remained in place. This effect held throughout the experimental session, suggesting that participants could not resist tracking the relations and their implied physical contingencies, even though these factors could not be used to predict final target locations. We propose that the mind updates object identities and their locations not only according to how individual objects move, but also according to the physical relations between them. In other words, relations—and their entailments about where things should be—influence core processes of attention and visual cognition.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

Thanks for visiting! Feel free to contact me at ahafri@gmail.com with any comments or questions.

You can try out the task yourself at https://www.perceptionresearch.org/CupsAndBalls.

For a pre-print of our latest study on the perception of abstract relations, visit https://perception.jhu.edu/relations. (You'll find the answer to the question, "Does a phone in a basket look like a knife in a cup?". The answer is yes.)

Abstract ID: 1615

Attention: Features, objects, selectivity

Linking the effects of exogenous attention on contrast sensitivity and on apparent contrast

Talk Presentation - *Topic area: Attention: Features, objects, selectivity*

Luke Huszar[1] (ldh319@nyu.edu), Antoine Barbot[1,2], Marisa Carrasco[1,2]; [1]Department of Psychology, New York Unviersity, [2]Center for Neural Science, New York University

[Goal] Attention modulates visual appearance (review, Carrasco & Barbot, 2019), playing a fundamental role in our subjective impression of the visual world. However, research has predominantly focused on how attention alters visual sensitivity. Here, we investigated whether attentional effects on contrast sensitivity and appearance share a common cause. We concurrently measured the effects of exogenous attention on contrast sensitivity and apparent contrast, and used psychophysical reverse correlation and computational modeling to link these effects. [Methods] Observers reported which of two Gabor patches was of higher contrast. One stimulus had fixed contrast ('standard', 40%), while the other varied ('test', 7-100%). Stimuli were embedded in noise that randomly varied across trials. Exogenous attention was manipulated using pre-cues briefly flashed above one (Cued condition) or both stimuli (Neutral condition). To measure the effect of attention on appearance, we estimated the point-of-subjective equality (PSE) between conditions. For reverse correlation, trial-to-trial fluctuations in stimulus energy were correlated with behavioral judgments to assess how sensitivity to orientation and spatial frequency content influenced apparent contrast. Contrast sensitivity kernels for each condition were fit with 2D Gaussians to evaluate whether and how attention changed the amplitude, tuning width, and/or baseline of these sensitivity profiles. [Results] Exogenous attention increased apparent contrast: the Cued PSE differed from the point of objective equality (40% contrast), while the Neutral PSE matched it. Reverse correlation revealed higher sensitivity for Cued than Neutral, with Gaussian fits to both individual observers and the mean capturing this difference as a change in multiplicative gain. Model simulations evaluated the extent to which different perceptual and attentional gain control mechanisms could account for the results. [Conclusion] Our findings link the effects of attention on perceptual sensitivity and appearance by showing how changes in sensitivity manifest as differences in subjective appearance.

Acknowledgements: NIH NEI R01-EY027401, NIH NEI R01-EY019693

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1159

Phasic pupillary response modulates object-based attentional prioritization

Talk Presentation - *Topic area: Attention: Features, objects, selectivity*

Miranda Scolari[1] (miranda.scolari@ttu.edu), Sean O'Bryan[1]; [1]Texas Tech University

Visual attention studies have demonstrated that the shape of space-based selection can be governed by salient object contours: when a portion of an enclosed space is cued, the selected region extends to the full enclosure. Although this form of object-based attention (OBA) is well-established, one continuing investigation focuses on whether this selection is automatic or under voluntary control. We attempt to dissociate between these alternatives by measuring phasic changes in pupil diameter—known to fluctuate with top-down attention—during a classic two-rectangle paradigm. An endogenous spatial pre-cue directed voluntary space-based attention (SBA) to one end of a rectangular frame. We manipulated the reliability of the cue, such that targets appearing at an uncued location within the frame occurred at low or moderate frequencies. OBA effects were only marginally observed when reliability of the spatial cue was low (and hence, uncued targets were moderate), and consistent with previous findings, attention selection was primarily driven by probabilistic prioritization. These results run counter to the predictions of an automatic spread account. Next, we examined pupil size time-locked to the cue display, which was expected to reflect top-down processing of the spatial cue. We reasoned that if OBA is controlled analogously to SBA, then object selection should emerge only when it is behaviorally expedient and when phasic pupil size reflects a high degree of top-down attention to the cue display. Our results bore this out. Thus, we conclude that OBA was voluntarily controlled, and furthermore show that pupil diameter may be used to interrogate attentional strategy.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1278

Preserved perception of simple visual features in stimulus-based neglect

Talk Presentation - *Topic area: Attention: Features, objects, selectivity*

Seda Akbiyik[1] (sakbiyik@fas.harvard.edu), Teresa Schubert[1], Alfonso Caramazza[1]; [1]Harvard University

Evidence from visuospatial neglect sheds light on visual object and word recognition processes. While neglect disrupts awareness for contralesional information, there is ongoing debate about the extent of perceptual processing for the neglected portion. Despite a few reports of implicit processing of visual features in hemifield neglect, it is unclear the extent to which this information reaches awareness and at what level perceptual features are bound into an integrated representation. In this study, we tested a 68-year-old man with stimulus-based left neglect- a deficit in recognition of the left half of visual objects, regardless of their location in the visual field (Figure S1A). We performed a series of experiments manipulating single visual features (color, orientation, form), feature conjunctions, and complexity, on the left/right sides of a stimulus. Strikingly, we find that he can accurately report simple color, orientation, and form information from the left of stimuli (Figure S1B,C,D). However, he performed with characteristic difficulty in reporting complex form information, evidenced by poor object recognition and word reading. Our results show that simple visual features can be processed independently when multiple are present (Figure S1E), and dissociations can emerge between the processing of complex and simple features. At the level of visual processing consisting of a stimulus represented in spatiotopic coordinates, certain visual features (particularly complex form, Figure S1A,E) may require attention for binding into a unitary representation, while some may be accessed without attention. These results inform how coherent visual percepts are formed and reach awareness in normal perception.

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 727

Temporal attention selectively enhances gain only for target features

Talk Presentation - *Topic area: Attention: Features, objects, selectivity*

Luis D. Ramirez[1] (luisdr@bu.edu), Josh J. Foster[1], Sam Ling[1]; [1]Boston University

Temporal attention – the allocation of attention to a moment in time – improves perception of visual targets at that moment. What mechanisms underlie temporal attention's effects on perception? Perceptual template models (Lu and Dosher, 1998) highlight several mechanisms by which attention can improve perception. According to these models, attention can improve target perception through signal enhancement (i.e., increasing gain in sensory channels that encode the target stimulus, improving target discrimination even when the target is embedded in noise); stimulus enhancement (increasing gain across all sensory channels, which improves target discrimination solely when noise is low since noise would also be amplified); or noise reduction (reducing gain in channels that encode noise, which improves target discrimination solely when noise is high). To test which mechanism supports temporal attention, we measured contrast thresholds for a target grating embedded in varying levels of broadband noise in an orientation discrimination task. In half of the trials, temporal attention was directed by having the target onset preceded by an auditory pre-cue that allowed subjects to anticipate when the target would appear (cued condition). In the remaining trials, no auditory pre-cue was presented (uncued condition). We tested the mechanism supporting temporal attention by fitting a family of models that included signal enhancement, stimulus enhancement, noise exclusion, and all combinations of these mechanisms. Our modelling approach deviated from traditional perceptual template models in one important way: we incorporated divisive normalization to account for the cross-channel suppression that is known to occur between sensory channels (Baker and Vilidaite, 2014). We found that a temporal cue improved target discrimination across all noise levels, an empirical pattern that was best explained by a signal enhancement model. Thus, temporal attention appears to improve target perception by selectively increasing gain in sensory channels that are tuned solely for the target feature.

Acknowledgements: National Institutes of Health Grant EY028163 to S. Ling

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 322

Two Types of Attentional Footprint: Feature-based Enhancement and Suppression Leave Persisting Spatial Effects

Talk Presentation - *Topic area: Attention: Features, objects, selectivity*

Seah Chang[1] (seahchang@jhu.edu), Howard Egeth[1]; [1]Johns Hopkins University

Both target-feature enhancement and distractor-feature suppression can flexibly guide attention (Chang & Egeth, 2019). Although such effects are feature-driven, here we explore the possibility that enhancement and suppression effects persist at the locations where critical features were presented even when the features are no longer present. In the current study, search and probe trials were randomly interleaved. Participants searched for a diamond target among other shapes on half of trials (search trials) and searched for a probe target, either ‘A’ or ‘B’, among other letters on the other half of trials (probe trials). On search trials, two items including the diamond target were always in a target color while the other two items were in a distractor color. Color roles were consistent across trials. On probe trials, four ovals were presented, one of which was in either a target or distractor color and the other three ovals were in neutral colors that never appeared on search trials. Participants learned the target and distractor features through search trials while probe trials assessed the underlying attentional template that guided visual search. In Experiment 1, on probe trials letters were presented on the ovals. On target-color-present trials, a probe target on a target-colored oval was identified faster than one on a neutral-colored oval, showing target-feature enhancement. On distractor-color-present trials, a probe target on a distractor-colored oval was identified slower than one on a neutral-colored oval, showing distractor-feature suppression. More interestingly, in Experiment 2 substantial enhancement and suppression effects were observed even when the ovals were removed 1,500 ms before the presentation of the probe letters. The probe letters appeared on a blank background in the locations that had been occupied by critical (target- or distractor-colored) or neutral ovals. Feature-based enhancement and suppression leave persisting spatial effects in locations vacated by critical features.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for stopping by my presentation page!

I will be available to answer your questions through asynchronous chat or during the scheduled Zoom session. If you have further questions after the conference or would like to reach me, please e-mail me at: seahchang@jhu.edu

Abstract ID: 1187

Attention: Memory

Environmental Updating of Attentional Goals

Poster Presentation - *Topic area: Attention: Memory*

Samantha Joubran[1] (sjoubran@uoguelph.ca), Naseem Al-Aidroos[1]; [1]University of Guelph

Can attentional goals spontaneously align to an environment through cyclical interactions between attention and visual working memory (VWM)? Representations in VWM can serve as attentional goals that modulate how stimuli capture attention; in turn, stimuli that capture attention are more likely to be encoded in VWM. Might such interactions allow new attentional goals to be adopted based on the relationship between past goals and the stimuli currently in the environment? Here, on every trial we had participants remember a shape and then complete two visual searches. In the first search, one of the distractor locations contained a shape singleton that was either a match or non-match with the shape in memory, and all items were heterogeneously coloured. The shape singleton should more strongly capture attention on match trials. Does this attentional bias cause the singleton to be encoded in memory, allowing its randomly chosen colour to serve as a new attentional goal? To assess this possibility, in search two all search items were circles, and one distractor was a colour singleton that either matched the colour of the search-one shape singleton or not. As is typically found, in search one we observed longer search times when the shape singleton matched the shape in memory, suggesting that memory biased attentional capture towards matching stimuli. We also found that, on these search-one matching trials, search-two reaction times were slower when the colour singleton matched the colour of the search-one shape singleton; no such difference was found on search-one non-matching trials. Thus, the stimulus that most strongly captured attention on search two was determined by physical properties of the stimulus that captured attention on search one. These findings are consistent with spontaneous updating of attentional goals following cyclical interactions between working memory, attention, and the environment.

Acknowledgements: This work is supported by an NSERC grant given to Dr. Naseem Al-Aidroos.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

If you cannot attend the zoom meetings for this presentation and you do have questions about this work please feel free to email me at sjoubran@uoguelph.ca

Have an amazing day!

Abstract ID: 159

Feature avoidance errors when learned spatial probabilities guide attention to a nontarget

Poster Presentation - *Topic area: Attention: Memory*

William Narhi-Martinez[1] (narhi-martinez.1@osu.edu), Veronica Olaker[1], Jiageng Chen[1], Julie D Golomb[1]; [1]The Ohio State University

The ability to accurately perceive and remember object features depends greatly on where attention is focused (Treisman, 1998). Past work has examined how top-down or bottom-up attentional guidance influences object feature reports. For example, when attention is divided between objects at two locations and participants later report the color of one of the objects, responses reflect some mixing of the objects' colors, while when attention is shifted to or captured by another object, responses instead reflect some swapping of a distractor color (Golomb, L'Heureux, & Kanwisher, 2014; Chen, Leber, & Golomb, 2019). The present study sought to examine whether manipulating spatial attention with an experience-dependent cue would induce feature errors more similar to goal-directed or bottom-up attentional manipulations. We used a spatial probability cue (Geng & Behrmann, 2005) to guide attention to one of four locations that colored squares appeared in; the target was biased to appear in one of the locations (high-probability) most frequently. Participants reported the color of the target square on a continuous color wheel. Across several experiments we tested how the presentation of the target probe (simultaneous with or following the array) and a probabilistic pre-cue affected the impact of the spatial probability cue. Our results showed that a spatial probability cue does not have the same effect on feature response errors as either goal-directed or bottom-up guidance. Instead, participants tended to avoid the feature in the high-probability location when it was not the target; i.e., report a color repulsed away from the color of the high-probability distractor. Additional experiments examined if this feature avoidance emerged due to an attentional bias strong enough that only the high-probability item was encoded, and subsequently avoided during target report. Overall, we conclude that experience-driven attentional guidance has a unique impact on how color features are encoded and remembered.

Acknowledgements: NIH R01-EY025648 (JG), NSF 1848939 (JG)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

If you are enabling subtitles during my presentation video, I recommend selecting the "English" option for maximum accuracy.

Abstract ID: 808

Feature uncertainty is tracked by predictive attentional templates

Poster Presentation - *Topic area: Attention: Memory*

Phillip Witkowski[1,2] (pwitkowski@ucdavis.edu), Joy Geng[1,2]; [1]Department of Psychology, University of California, Davis, [2]Center for Mind and Brain, University of California, Davis

Recent research on working-memory (WM) suggests that representations held in WM are not necessarily static representations of past data, but can serve as dynamic representations of expected information. Nobre and Stokes (2019) recently introduced the term “premembering” to describe this proactive role for memory in attention. If true, then it should be possible to dissociate the remembered representation of a previously seen “cue” stimulus from the “premembered” expectation of a future target by statistically manipulating what will happen during search. We asked subjects to search for a target RDK after seeing a “cue” with a specific color and direction of motion (Supplemental S1). The target varied from the cue in predictable ways: one feature dimension (e.g., motion) was drawn from a distribution narrowly centered over the cued feature (low-variance dimension) and the other feature (e.g., color) was sampled from a broad distribution (high-variance dimension). The standard deviation of the low-variance distribution changed over the experiment. In Experiment 1, there were additional “probe” trials on which subjects reported the remembered features of the cue using a color or motion wheel. Analysis of RTs showed that subjects were sensitive to changes in the variance of the low-variance dimension but, probe responses showed WM representations were not sensitive to these changes (S2). Experiment 2 used the same design but “probe” trials asked subjects to predict the target features. This tested whether expectations factor into predictive representations rather than changing the content of memory items. We replicated the RT results from Experiment 1 showing that response-times were sensitive changes in variance, but additionally show that the precision of probe responses changed in step with the variance of the low-variance distribution (S3). These results show a fundamental distinction between how expectations about upcoming sensory data factor into premembered versus remembered representations.

Acknowledgements: NIH-RO1-MH113855-01

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 321

Global alpha suppression indexes the zoom lens of attention

Poster Presentation - *Topic area: Attention: Memory*

Emma E. Megla[1], Sisi Wang[1], Geoffrey F. Woodman[1]; [1]Vanderbilt University

Human alpha band activity (8-12 Hz) has been proposed to index the storage of arrays of representations in visual working memory, showing stronger suppression as the set size of to-be-remembered objects increased. However, the results of recent studies suggest that global alpha suppression might instead index attentional selection. How do we reconcile these competing explanations? If alpha suppression indexes attentional selection, then perhaps this signal is stronger when larger arrays are shown, because the focus of attention has to zoom out to select all of the objects in the array. When an array has fewer items, then the spatial extent is smaller. When the array has more items, then the spatial extent is larger. Here, we tested this hypothesis by varying the distance between multiple objects while keeping their numbers constant in low and high memory set size conditions. Our results show that the global alpha suppression was strongest when the distance separating the items was greatest, but was not modulated by memory set size. In contrast to this pattern of global alpha suppression, the neural index of visual working memory storage—the contralateral delay activity—became stronger when the memory set size increased, but was not modulated by the distance between objects. These results suggest that global alpha suppression during the visual working memory delay period reflects the spatial extent of attention and not visual working memory storage itself. This provides a more precise understanding of the attention mechanism of global alpha suppression during visual processing.

Acknowledgements: The present work was supported by the National Institutes of Health (R01-EY019882, R01-MH110378, P30-EY08126, and T32-EY007135).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 531

Goals matter: Only searched-for visual working memory representations form an attentional control set.

Poster Presentation - *Topic area: Attention: Memory*

Lindsay Plater[1] (lplater@uoguelph.ca), Blaire Dube[1], Maria Giammarco[1], Kirsten Donaldson[1], Krista Miller[1], Naseem Al-Aidroos[1]; [1]University of Guelph

Attentional control settings (ACSs) guide attention in our complex visual environments by determining which objects capture our spatial attention. Both episodic long-term memory and semantic memory can support ACSs, but the role of visual working memory (VWM) remains unclear. Here, we assessed whether objects represented in VWM form an ACS and control attentional capture. In Experiment 1, participants maintained a colour in memory while completing a modified Posner cueing task that was designed to measure both singleton distractor costs and spatial cueing effects. The memory colour changed on each trial to limit the contribution of long-term memory. In Experiment 1, we replicated the typical finding of greater singleton capture by cues that matched the memory colour, indicating that the colour was represented in active VWM and produced an attentional bias. There was, however, no effect on spatial cueing; all cues produced comparable spatial cueing effects, even when they did not match the colour maintained in memory, indicating that the memory colour did not form an ACS. In Experiment 2, we adjusted the Posner cueing task so that participants had to search for the colour held in VWM. We again found enhanced singleton distractor costs by memory matching cues. Critically, the searched-for colour maintained in VWM formed an ACS; only memory matching cues, but not non-matching cues, produced a spatial cueing effect. These experiments contribute two important findings: 1) merely representing an object in active VWM is not sufficient for the representation of that object to form an ACS (Experiment 1), and 2) participants can form an ACS even when the searched-for colour changes from trial to trial, suggesting that—like episodic and semantic long-term memory—VWM can support ACSs (Experiment 2).

Acknowledgements: This work was supported in part by an NSERC grant to Dr. Naseem Al-Aidroos and an NSERC scholarship to Lindsay Plater.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Welcome! My name is Lindsay Plater, I am a PhD student at the University of Guelph in Ontario, Canada. This work is part of my PhD thesis; please feel free to e-mail me at lplater@uoguelph.ca if you have any questions or comments, or attend my presentation times to ask your questions in person.

This work is currently in prep for publication with an additional experiment (Experiment 3) showing that you can only maintain one VWM ACS; when searching for two targets on each trial, neither capture visual attention. Let me know if you'd like a copy of the paper once it's published!

Abstract ID: 151

Memorability in Hybrid Visual Search

Poster Presentation - *Topic area: Attention: Memory*

Nancy Carlisle[1] (nancy.carlisle@gmail.com), Ziyao Zhang[1]; [1]Lehigh University

Hybrid visual search tasks typically require participants to search for more potential targets than could simultaneously be maintained in visual working memory. Therefore, these tasks require long-term memory templates. In this research, we examine whether another factor of long-term memory, memorability, influences hybrid search performance. Participants searched for 8 target items within search arrays of set size 1, 8, or 16. Half of the target items were drawn from a low memorability set and half from a high memorability set. All participants had to achieve 95% accuracy or higher during a memory test for the search targets in order to proceed to the search task. During visual search, accuracy was higher for visual search trials containing a high memorable target, and reaction times were faster for high memorable targets. This suggests that factors related to long-term memorability of items also impact their ability to serve as attentional templates during visual search.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 157

Memory for a Salient Distractor is Suppressed by Past Experiences

Poster Presentation - *Topic area: Attention: Memory*

Bo Yeong Won[1] (boyeong.won@gmail.com), Joy Geng[1]; [1]University of California, Davis

Recent studies have shown that past experiences with salient distractors lead to better suppression. However, there is disagreement over how deeply the salient distractor is processed. In this study, we directly measured memory for a salient distractor with a surprise memory trial. Two groups, SingletonTrained (N=320) and Control (N=320), were asked to find a shape singleton among five identically shaped distractors. All stimuli were gray in color. The SingletonTrained group saw a color singleton on 80% of trials; the Control group saw only one color singleton trial. Both groups unexpectedly encountered a “surprise memory trial” at some point where they were asked 1) whether the preceding search display

contained a color singleton; 2) how confident they were in their response; 3) the color of the singleton; 4) where the color singleton was located. Critically, eight sub-groups (N=40 each) experienced the memory trial at different time points in the experiment (e.g., in the SingletonTrained group following the first singleton vs. the 24th singleton; in the Control group, following the only singleton occurring on the first vs. the 24th trial). Subjects that saw more color singleton trials before the memory trial showed stronger suppression (ie., less RT interference), reported seeing the color singleton less often, had lower confidence in their reports, and also showed poorer memory for the color and location of the color singleton than the Control group. This pattern was also seen at the individual level such that subjects with stronger attentional capture by the color singleton also had a better memory of its color and location. Together these findings suggest that learned suppression of attention to salient distractors leads to less search interference and less precise memories of the distractor.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 883

Multiple Target Templates are Maintained without a Cost to Precision

Poster Presentation - *Topic area: Attention: Memory*

Ryan Williams[1] (ryanscott.williams@mail.utoronto.ca), Susanne Ferber[1], Jay Pratt[1]; [1]University of Toronto

The representational properties of target templates (i.e., the top-down biasing of target features) are set by target-distractor relationships, with target features being more narrowly represented when distractors resemble targets. Here we examined the representational properties of target templates under single- versus dual-target search. In Experiment 1, we employed a contingent capture task that required search for either a single target-defining color or two target-defining colors in either easy (low target-distractor similarity) or difficult (high target-distractor similarity) search contexts. For both single- and dual-target search, we found that attention was captured by target-similar precues (30° away from the target in 360° hue space) when targets and distractors were visually disparate (easy search). When targets and distractors were visually alike (difficult search), attention was selectively captured by target-matching precues. Thus, representations of target features are malleable by target-distractor relationships in dual-target search. In Experiment 2, we examined whether a loss of precision is observed in the representation of target features when multiple templates are prioritized, as is the case when multiple items are stored in visual working memory. We first determined a 20° difference in 360° hue space as the cut-off point between the target

color and non-target color in a single-target, difficult search context. We then administered the difficult-search, contingent capture task from Experiment 1, with either a single target color or two target colors, but now included target-similar precues that were 20° away from the target color(s). As before, we found that for both single-target and dual-target search, attention was captured by target-matching precues but not by target-similar precues. Overall, these results indicate that multiple target templates can be maintained simultaneously without a cost to precision and provide evidence against the view that target templates are stored in working memory – at least when target features remain constant across time.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 316

Rhythmic fluctuations of internal visual search templates

Poster Presentation - *Topic area: Attention: Memory*

Ulrich Pomper[1] (ulrich.pomper@univie.ac.at), Ulrich Ansorge[1]; [1]Faculty of Psychology, Department of Basic Psychological Research and Research Methods, University of Vienna

Recent evidence suggests that visual attention does not operate continuously over time, but that attention rhythmically highlights task relevant locations, objects, or features, at a rate of between 4 to 12 Hz. So far, this attentional sampling mechanism has been demonstrated with regard to external stimuli. In the present study, we investigated whether a similar mechanism might apply to the internal visual representations that guide human vision. Specifically, we were interested in whether two visual target-orientation representations are continuously maintained in working memory at a constant fidelity, or whether the representations are activated alternatingly, similar to attended stimuli in our external environment. We used a matching-to-sample task. At the beginning of each trial, two bar-shaped orientation stimuli were presented as a template sequentially in direct succession, for 200 ms each. These template bars were oriented at 0°, 45°, 90°, or 135°, and indicated which target stimulus the participants had to respond to. Following a variable inter-stimulus interval of between 500 to 1,700 ms, a target Gabor patch was presented, and participants had to perform a speeded response if its orientation matched one of the templates. Task difficulty was continuously adjusted to produce around 66% correct responses, by changing the contrast of the Gabor. We analysed the individual hit-rate as a function of the interval between the second template and the target, separately for targets with orientations corresponding to the first and second template. Using permutation statistics, our data exhibit significant oscillatory patterns at 9 Hz, both

for targets matching the first- and the second template. This suggests that the internal representations of visual templates fluctuate over time.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Many thanks for visiting this poster!

Please note, that details of the presented study have changed compared to the abstract, as we since slightly adopted the experimental paradigm und have now collected a full dataset.

Also, we do realize that a specific limitation for our current conclusions is, that only Targets matching Template B exhibit a significant peak in the spectrum at 6Hz (Box 4, right plot). Idealy, both conditions would have shown such a peak. However, our finding of a highly significant difference in phase angles between these conditions (Box 5, right plot; assessed via permutation statistics) supports our interpretation of an anti-phase relationship of performance at 6Hz.

Again, if you have comments or questions, I'd be happy if you would get in touch.

Kind regards,
Ulrich Pomper

Abstract ID: 1372

Attention: Perception, memory

Attention strategies for learning under reducible and irreducible uncertainty

Talk Presentation - *Topic area: Attention: Perception, memory*

Marcus Watson[1] (watsonmr@yorku.ca), Mazyar Fallah[1], Thilo Womelsdorf[1,2]; [1]York University, [2]Vanderbilt University

In feature learning, uncertainty about feature values is reduced. Selective attention can help this, implying that agents should focus attention more under greater expected uncertainty about action outcomes. Little work tests this “attention-for-learning” prediction, and in particular it is unknown whether attention-for-learning is sensitive to the degree to which uncertainty can actually be reduced. Here we tested the attention-for-learning hypothesis in a naturalistic learning task that manipulated both reducible and irreducible forms of uncertainty, and quantified the strength of selective attention using attention-augmented reinforcement learning (RL) models. Human participants performed a 2-AFC object selection task in which multidimensional objects with a particular feature were more likely to be rewarded. Reducible uncertainty was manipulated between blocks by having objects vary along either two or five possible feature dimensions (different arms, body shapes, patterns, textures, or colors). Irreducible uncertainty took the form of different reward probabilities, either 0.70 or 0.85. As expected, when either form of uncertainty was higher, response times were longer, learning was slower, and asymptotic performance was lower. On blocks where one form of uncertainty was high and the other was low, these performance measures did not differ. However model results show that this similar performance was the result of different mechanisms. Specifically, when reducible uncertainty was high and irreducible uncertainty was low, participants had narrower attentional focus and greater exploratory biases than in the opposite condition. These results demonstrate that attention flexibly adjusts to the specific type of decision uncertainty. When faced with high levels of reducible uncertainty, attention becomes more focused and exploration increases, but the reverse is true for irreducible uncertainty, even when the resulting behaviour is highly similar. Taken together, these findings provide quantitative evidence for flexible adjustment of attention during learning to specific types of experienced uncertainty.

Acknowledgements: This work was supported by grant MOP 102482 from the Canadian Institutes of Health Research (TW) and by the Natural Sciences and Engineering Research Council of Canada Brain in Action CREATE-IRTG program (MRW, TW).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 5:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Feel free to email me at watsonmr@yorku.ca with any questions or comments

Quaddle objects scripts, manual, etc can be found on this repository: https://github.com/att-circ-contrl/Quaddles-Gen

USE experimental suite is here: https://github.com/att-circ-contrl/use

Abstract ID: 1493

Dissociable neural mechanisms underlie effects of attention on visual appearance and response bias

Talk Presentation - *Topic area: Attention: Perception, memory*

Sirawaj Itthipuripat[1,2,3] (itthipuripat.sirawaj@gmail.com), Viola Stoermer[2], Geoffrey Woodman[3], John Serences[2]; [1]Learning Institute and Research in Enigmatic Aesthetics Knowledge Laboratory, King Mongkut's University of Technology Thonburi (KMUTT), [2]Neurosciences Graduate Program, Department of Psychology, and Kavli Foundation for the Brain and Mind, University of California, San Diego (UCSD), [3]Department of Psychology, Center for Integrative and Cognitive Neuroscience, and Interdisciplinary Program in Neuroscience, Vanderbilt University (VU)

Researchers have long debated whether attention can change perception and alter visual appearance, or whether attention only induces response bias. Recent psychophysical findings suggest that attention can have both of these types of effects, depending on stimulus visibility and decision uncertainty of the behavioral task. While this evidence helps reconcile the two competing accounts, it is still unknown how these different effects of attention are implemented in the brain. Using EEG, we found that the two behavioral effects of attention could be explained via different patterns of attentional modulations on different neural markers of visual processing. Specifically, the early visually evoked potential at ~100ms post-stimulus (i.e., the P1 component) appeared to underly subjects' changes in visual appearance, whereas alpha-band oscillations (i.e., the posterior occipital 10-12Hz activity) appeared to underly subjects' response bias. Specifically, attention enhanced the multiplicative response gain (or the slope) of the early visual-cortical response (the P1-based contrast response function (CRF) or the P1 amplitude measured as a function of visual contrast). At the same time attention led to an additive shift of the neural CRF based on the posterior occipital alpha band activity, which appeared to be responsible for changes in the lateralized readiness potential and subjects' response bias. These findings suggest that attention biases both early visual perception and later stages of decision-making. Moreover, these two effects of attention are supported by dissociable neural mechanisms at different stages of visual information processing.

Acknowledgements: Thailand Science Research and Innovation (TSRI 62W1501) to SI; NIH R01-EY025872 and James S. McDonnell to JTS

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 630

Prior expectations evoke stimulus templates in the deep layers of V1

Talk Presentation - *Topic area: Attention: Perception, memory*

Fraser Aitken[1] (f.aitken@ucl.ac.uk), Georgios Menelaou,[2], Oliver Warrington[3], Nadege Corbin[3], Martina Callaghan[3], Peter Kok[4]; [1]University College London

During perception, the complex and noisy visual information relayed by our eyes is interpreted within the context of prior knowledge and expectations. The neural circuitry underpinning this process of inference is currently unknown. Recent neural theories of perceptual inference propose that neurons in the deep layers of cortex represent expectations, which in turn modulate sensory processing in the middle and superficial layers. However, direct support for this idea is limited due to the significant challenge of resolving cortical layers using human neuroimaging. Here, we capitalise on ultra-high resolution 7T functional magnetic resonance imaging (fMRI) to probe stimulus-specific activity induced by prior expectations in deep, middle and superficial layers of the human primary visual cortex (V1). In order to induce expectations, we presented participants (N=18) with coloured dot cues that predicted the likely orientation of an upcoming grating stimulus. On 75% of trials, gratings with the predicted orientation were presented. On the remaining 25% of trials, the predicted gratings were omitted. Crucially, as no stimulus was presented to the eyes in these 'omission' trials, any activity in V1 could be considered to arise solely from top-down inputs. Results showed that such predicted-but-omitted gratings led to an orientation-specific BOLD response in the deep, but not the middle and superficial layers of V1. In contrast, actually presented stimuli activated all layers of V1. These results provide novel insights into the neural circuitry by which the brain integrates prior expectations with sensory inputs in the service of perceptual inference.

Acknowledgements: The Wellcome Centre for Human Neuroimaging is supported by core funding from the Wellcome Trust (203147/Z/16/Z). Dr Peter Kok is supported by a Sir Henry Dale Fellowship jointly funded by the Wellcome Trust and the Royal Society (Grant Number 218535/Z/19/Z).

This talk will be presented in Live Talk Session 6, Tuesday, 23 June, 7:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 184

Space and Time Dissociate in the Construction of the Visual Now

Talk Presentation - *Topic area: Attention: Perception, memory*

Aditya Upadhyayula[1] (supadhy6@jhu.edu), Ian Phillips[1], Jonathan Flombaum[1]; [1]Johns Hopkins University

How are events occurring at different times and places integrated into a unified experience of what is happening now? We report experiments that sequester and dissect the visual now. In particular, we consider how a moment of visual experience combines events occurring at different times and locations. Our first two experiments rely on a Rapid Serial Visual Presentation (RSVP) paradigm, because serial error distributions in the paradigm generally suggest temporal uncertainty in visual experience. In each trial an RSVP stream of letters appeared at the fovea. Participants reported the letter in the stream that they perceived simultaneously with a transient peripheral cue. In Experiment 1, participants made errors, sometimes reporting letters from the stream that actually appeared before or after the cue. The pattern of errors suggests that the cue arrived in visual experience faster than the foveated RSVP stream. Critically, eccentric cues produced more before errors than parafoveal cues. In other words, eccentric cues appear to arrive in experience faster than parafoveal cues. These effects cannot be explained by Posner-like attention shifts, which predict the opposite pattern (errors on letters that appear after the cue). In Experiment 2, the cue was presented between two letters in the RSVP, producing results that conceptually replicate Experiment 1. Finally, in Experiment 3, we sought to further understand how eccentricity influences temporal experience.Participants reproduced the durations of discs that appeared at either eccentric or more foveal positions. Peripheral discs were reliably reported as lasting longer than foveated ones, given thesame objective duration. Collectively, these results suggest that space and time dissociate as events are stitched into a moment of experience

Acknowledgements: NSF PAC 1534568

This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Hi I am Adi Upadhyayula. I hope you are all staying safe during these troubling times! I am a 4th year graduate student working with Jon Flombaum & Ian Phillips at Johns Hopkins University. I work on time perception, and comics! This year I am excited to share some of my work that I did with Ian Phillips and Jon Flombaum on time perception. We have a talk and a poster. I will be graduating next year, and I am also looking for post docs beginning next Summer / Fall. Please drop me an email at "supadhy6 at jhu dot edu" if you want to chat more about my research. I am looking forward to meeting you all!

Abstract ID: 1433

The Influence of Taxonomic and Thematic Object Relationships on Attentional Allocation

Talk Presentation - *Topic area: Attention: Perception, memory*

Joseph Nah[1] (josephcnah@gmail.com), Joy Geng[2]; [1]University of California, Davis

Decades of research have provided evidence that high-level conceptual information can influence attentional allocation when task-relevant. Accumulating evidence in recent years has also demonstrated that the influence of semantic information on attention is not restricted to task-relevant situations (Shomstein, Malcolm, & Nah, 2019). These results demonstrate that high-level associations in the real-world automatically and continuously influence attentional processing. So far, however, the definition of “semantic” within the attentional literature has only been broadly construed. However, within the concept literature, semantic associations are divided into two types: taxonomic (i.e., similar intrinsic features, dog - bear) and thematic (i.e., common co-occurrence, dog - leash) relationships. This division is supported by behavioral and neural evidence (Mirman, Landridgan, & Britt, 2017). Here, we investigate whether attentional allocation is sensitive to the taxonomic and thematic relationships between objects. Participants were presented with two objects appearing on either side of fixation. The two objects were taxonomically, thematically, or neutrally related to one another. After 750ms, a Gabor patch appeared in the center of each object. Participants reported whether the orientation of two target Gabors were matched or mismatched. Shortest response times were observed when the objects were thematically-related, followed by the taxonomically-related and neutrally-related objects; all were significantly different from each other. When the object presentation time was shortened (500 ms), however, there was no difference between any of the three conditions. These results suggest that the efficiency of attentional allocation is sensitive to the specific type of semantic relationships and evolves over time (Malcolm, Rattinger, & Shomstein, 2016). Thus, while the semantic influence of task-irrelevant taxonomic and thematic relationships between objects follow a similar time course, the amount of influence depends on the type of relationship. This suggests that the distribution of attention is sensitive to the pre-existing organization of semantic networks in the brain.

Acknowledgements: This work was supported by NIH grant NIH-RO1-MH113855-01 to JG

This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Thank you for stopping by! For any questions or comments, please come to the live session, type in chat, or email me at: cnah at ucdavis dot edu

Abstract ID: 419

The speed of attentional engagement and its relation to working memory encoding in RSVP tasks

Talk Presentation - *Topic area: Attention: Perception, memory*

Alon Zivony[1] (alonzivony@gmail.com), Martin Eimer[1]; [1]Birkbeck, University of London

It is widely agreed that encoding information into working memory (WM) depends on attention allocation processes. We examined the hypothesis that the temporal dynamics of attentional engagement determine the outcome of WM encoding in RSVP tasks. We employed a task where two lateralized streams containing letters and digits appeared in rapid succession. A target object was closely followed by a (post-target) distractor that shared the target's response dimension, such that participants often erroneously report its identity. In a series of three experiments, the speed of attentional engagement was tracked by measuring N2pc components, separately for trials where participants correctly identified the target and intrusion trials where participants reported the digit that followed the target. Across experiments, the onset of the target-locked N2pc was correlated with the speed the target-defining feature was detected. Within each experiment, intrusions were associated with later target-locked N2pc onsets relative to correct trials. Thus, these experiments showed that distractor intrusions occur when attentional engagement is slow and enhances the distractor instead of the target. In a second series of experiments, we examined the fate of the target on trials where participants committed distractor intrusions. When participants were given the opportunity to provide two distinct responses, intrusions were followed by above-chance target identification. When the post-target distractor was excluded as a possible response, accuracy improved but was below baseline performance. A final experiment revealed that the presence of the distractor did not affect the representational quality of the target, but instead blocked WM encoding on part of trials. Together, these findings suggest the existence of a mechanism in which perceptual information is accumulated and compared to the attentional set prior to attentional engagement. This mechanism introduces variability in the speed of attentional engagement that affects feature activation, which in turn determines WM encoding and perceptual reports.

Acknowledgements: This work was supported by a Newton grant from the British Academy (grant number NIF\R1\180384) to A. Zivony.

This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 8:00 am EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

you can find the accepted version of the article expanding on experiments 1-3 here:
https://sites.google.com/site/alonzivony/publication
and here:
https://drive.google.com/file/d/1BD7X8vRmJqTHv-gCGd9o6Naiuz4kg5FM/view?usp=sharing

Abstract ID: 386

Attention: Space

Decoding visual spatial attention control

Poster Presentation - *Topic area: Attention: Space*

Sreenivasan Meyyappan[1], Abhijit Rajan[1], Jesse Bengson[3], George Mangun[2], Mingzhou Ding[1]; [1]J.Crayton Pruitt Family Department of Biomedical Engineering, Univ. of Florida, Gainesville, FL, [2]Center for Mind and Brain Univ. of California, Davis, CA, [3]Department of Psychology, Sonoma State University, Rohnert Park, CA

Deploying anticipatory visual spatial attention in advance of stimulus onset enhances the processing of task-relevant stimuli and suppresses distraction. In this study, we investigated the neural representations of attention control signals in visual cortex by analyzing two fMRI datasets, one recorded at University of Florida (n=13) and the other at University of California, Davis (n=18), using machine learning techniques. In both datasets, the participants performed a cued visual spatial attention task, in which each trial began with a cue, instructing the subject to either attend the left or the right visual hemifield. After a random delay, a grating (Gabor patch) was presented in one of the two hemifields, and the subject was asked to discriminate the spatial frequency of the grating in the attended hemifield and ignore the grating appearing in the un-attended hemifield. Estimating cue-evoked fMRI responses trial by trial and applying multi-voxel pattern analysis (MVPA) to multiple ROIs within the visual cortex, we found the following results. (1) Accuracy of decoding attend-left versus attend-right was significantly above chance level in all the ROIs within the visual cortex (average accuracy=65%). (2) The decoding accuracy was highly correlated across different visual ROIs with 80% of the variance explained by the first principal component. (3) Subjects with

higher decoding accuracy performed better on the task as indexed by lower inverse efficiency (response time/response accuracy). These results, consistent across the two datasets, suggest that (1) attention control signals are present in both high order (e.g., intra-parietal sulcus) as well as low order visual areas (e.g., primary visual cortex) and (2) the distinctness of the neural representations of attention control is a personal trait and explains individual differences in task performance.

Acknowledgements: NIH grant MH117991

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 156

Enhanced neural tuning in middle temporal area (MT) of the marmoset monkey during pre-saccadic attention

Poster Presentation - *Topic area: Attention: Space*

Shanna Coop[1], Jacob Yates[1], Jude Mitchell[1]; [1]University of Rochester

Recent psychophysical studies have described perceptual enhancements for the targets of saccades immediately prior to eye movements. These enhancements involve a sharpening of sensitivity around the target’s features consistent with feature gain (Li et al., 2016). Complementary neurophysiological studies have identified pre-saccadic enhancements in extra-striate cortex (Moore and Chang, 2009), but have not directly examined how neuronal tuning changes. We examined how neuronal tuning for motion direction in the middle temporal area (MT) of the marmoset monkey changed under pre-saccadic attention. Marmosets made a saccade from central fixation to one of several equally eccentric stimuli (full coherence motion dot fields). Marmosets were rewarded for selecting any of the targets, as long as their choice differed from the choice of the previous trial. For each trial, the direction of motion of each stimulus was independently sampled from 16 motion directions. MT responses were categorized based on whether the saccade was planned towards or away from the receptive field under study. Consistent with studies in macaque V4 (Moore & Chang, 2009), we find that neural sensitivity increases when the saccade is made towards the RF. We also examined changes in tuning curves by fitting an adjusted Von Mises function to the responses in each saccade (towards or away) condition. We find that neurons exhibit gain increase before saccades towards the RF, consistent with previous studies of covert attention (McAdams & Maunsell, 1999). However, while gain increases occurred across the epoch from 0 to 100 ms before the

saccade, other aspects of tuning (narrowing and baseline shifts) varied. We found greater narrowing at earlier pre-saccadic epochs followed by more additive increases near saccade onset. These findings support recent psychophysics which suggests that pre-saccadic attention involves not only gain increases but also an automatic feature-selective gain for the saccade target.

Acknowledgements: Funding: NIMH R21 MH104756, U01 NS 094330, NIH T32 EY007125

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Hello! Welcome to my virtual poster!

I will be hosting 3 Zoom meetings:
3:00 pm EST Friday 19th
9:00 am EST Monday 22nd
6:00 pm EST Monday 22nd
Please reach out to me if these times don't work you, I would be happy to schedule an additional meeting time: shannahcoop@gmail.com

PRIMATE POST-DOC WANTED
I have a strong research background with expertise in animal behavior, psychophysics, electrophysiology, and neuroanatomy. I am mainly interested in systems and circuit questions with a growing interest in social, comparative, and computational neuroscience. Please contact me if you have or know of any suitable positions open. Here is a link to my website: https://marmolab.bcs.rochester.edu/Coop/index.html

Abstract ID: 758

Gaze behavior reveals differences between location and identity tracking

Poster Presentation - *Topic area: Attention: Space*

Jiří Lukavský[1] (lukavsky@praha.psu.cas.cz), Filip Děchtěrenko[1], Hauke Meyerhoff[2]; [1]Czech Academy of Sciences, [2]Leibniz-Institut fur Wissensmedien

Many everyday-life situations require to track multiple visual object simultaneously. This encompasses situations in which it is sufficient to monitor the locations of objects (e.g., avoiding collisions in traffic) as well as situations in which the identity of the tracked objects is highly relevant (e.g. monitoring your own children on a playground). Here, we use an eye-tracking approach to study whether the process of location tracking (multiple object tracking; MOT) differs from the process of tracking of identities (multiple identity tracking; MIT). We take advantage of the observation that observers fail to distinguish repeated MOT trials, but their eye movements are similar between repeated presentations. In two experiments, we compared the gaze similarity in pairs of (1) repeated MOT trials, (2) repeated MIT trials and (3) repeated MOT-MIT trials (order counterbalanced). We evaluated the similarity using Pearson correlations for spatiotemporal scanpatterns smoothed with a Gaussian filter. In Experiment 1 (N=20), the tasks were presented in separate blocks, whereas they were intermixed in Experiment 2 (N=20). In both experiments, we consistently observed that the gaze patterns were most similar in repeated MOT trials (Exp.1: r = .443; Exp.2: r = .395). The similarity was lower when we compared repeated MIT trials (r = .333; r = .276) or repeated MOT-MIT trials (r = .305 or r = .251). In Exp.1, the similarity was higher if the participant started with the MOT trials than when they started with the MIT trials. Nevertheless, the intermixed trials in Exp.2 revealed analogous results. The results confirm the gaze patterns in repeated MOT trials are similar. Identical trials presented first as MOT and later as MIT (or vice versa) yield more different gaze patterns suggesting that MOT and MIT rely on distinct processes with the MOT process being more consistent across trials than the MIT process.

Acknowledgements: The research has been supported by Czech Science Foundation (GA19-07690S)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

- you can contact me on twitter @jlukavsky
- video contains closed captions if you prefer

Abstract ID: 367

Pre-motor shifts of attention evoked by bimanual pointing enhance perception

Poster Presentation - *Topic area: Attention: Space*

Marnix Naber[1] (marnixnaber@gmail.com), Joris Elshout[2], Stefan Van der Stigchel[3]; [1]Experimental Psychology, Helmholtz Institute, Utrecht University, The Netherlands

Before actually looking at or reaching for an object, the focus of attention is first allocated to the object. Here we investigated whether the perceptual benefits produced by these pre-motor shifts of attention cumulate if an object is targeted by multiple effectors (eyes and hands). Participants were cued to move either gaze or a single hand (one effector), two hands or both gaze and a hand (two effectors), or gaze and two hands (three effectors) to objects in the periphery. These eight objects suddenly changed identity and one distinct object (the probe) needed to be discriminated before the actual initiation of the movements. The probed object was either targeted by none (cue invalid), or one or more effectors (cue valid). Results showed that average discrimination performance decreased linearly per additional effector independent of cue validity, but also linearly increased per additional cue-valid effector that targeted the probed object. Moving two hands to the probed object resulted in better recognition performance as compared to moving only gaze or one hand. These results have three implications: (1) the more complex the motor program, the worse the performance, (2) the more effectors planned to move to the yet-to-appear object, the more attentional resources it receives and the better it is perceived, and (3) the cumulation of perceptual benefits points at parallel and presumably independent mechanisms that evoke pre-motor shifts of attention. We speculate that recognition may improve even further when more effectors (e.g., feet, posture, or head movements) are moved to objects.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 285

Probing mutual inhibition between attention regions using attention isolation

Poster Presentation - *Topic area: Attention: Space*

Grace Edwards[1,2] (gcaedwards1@gmail.com), Anna Berestova[3], Lorella Battelli[1,2,4]; [1]Istituto Italiano di Tecnologia, [2]Harvard University, [3]Lesley University, [4]Beth Israel Deaconess Medical Center

Attention to the left and right visual field is lateralized to right and left temporoparietal processing regions, respectively. Our stable visual percept suggests a complex relationship between these lateralized regions, yet this interaction is poorly understood. Here we test if lateralized attention regions interact via mutual inhibition. According to the mutual inhibition hypothesis, isolating attention to the right visual field (for example) should boost activity in the left attention regions, leading to the inhibition of the right attention regions, culminating in a decrease in attention in the left visual field. To investigate this hypothesis, we

presented bilateral multiple object tracking (MOT) stimuli to our participants (n=42), but had them isolate attention to one visual field for 30 minutes. We tested bilateral MOT before and after attention isolation to determine impact to the unattended visual field. Our participants were split into three groups: 1) attention isolated to right visual field (eye-tracker to ensure central fixation), 2) attention isolated to the left visual field, and control group 3) attend bilaterally using bilateral MOT. Surprisingly, we found attention isolation increased attention to the unattended visual field (Left: $t(13)2.98, p=0.01$; Right: $t(13)3.05, p=0.009$). The difference between visual fields after isolation was significant when attention was isolated right ($p=0.044$), but not left ($p=0.98$). Furthermore, when attention was isolated right, there was a significantly difference between the unattended visual field and the control ($p=0.032$). These results suggest prolonged activation of attention regions in one hemisphere does not subsequently inhibit attention regions in the opposite hemisphere, suggested by the mutual inhibition hypotheses. Instead, prolonged activation results in a boost of attention to the unattended visual field. The different impact of attention isolation to the left visual field provides elegant evidence of distinctive roles between lateralized attention regions, supporting a bilateral orientation vector in right temporoparietal areas.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 363

Pupillometric measurements reveal the characteristics of the attentional window

Poster Presentation - *Topic area: Attention: Space*

Shira Tkacz-Domb[1] (shirtzi@yahoo.com), Wolfgang Einhäuser[2], Yaffa Yeshurun[3]; [1]York University, [2]Chemnitz University of Technology, [3]University of Haifa

We examined whether the minimal size of the attentional window (i.e., its size when attention is narrowly focused) scales with eccentricity and whether it is affected by task difficulty, using attentional modulations of the pupillary light response (PLR) - pupillary constriction when covertly attending a bright area relative to attending a dark area. First, we presented rotating Ts to the right and left of fixation, surrounded by either

bright or dark task-irrelevant disks with varying distances from each T. The Ts appeared at an eccentricity of 3.5° (distances: 0.5° and 1°) or 6.5° (distances: 1° and 2°). A precue indicated which T to attend, and the task was to count the number of times the T was upright. In Experiment 1, stimuli size increased with eccentricity. We found attentional modulation of the PLR with a larger target-disks distance at the far than near eccentricity, suggesting a smaller window at the near eccentricity. In Experiment 2, stimuli size was fixed, regardless of eccentricity. We found attentional modulations of the PLR with all distances. Taken together, the results suggest that the window does not scale with eccentricity, but rather depends on stimulus size. In Experiment 3, six letters appeared on a central disk of which one was the target. The task was to identify the target. In the easy condition, the non-target letters were homogenous (low load). In the hard condition, they were heterogeneous (high load). Peripheral distracting letters appeared to the right and left of fixation on disks whose luminance changed sinusoidally from bright to dark at a frequency of 1.2 Hz. The amplitude spectrum of the pupil signal shows a larger amplitude at the disk frequency of 1.2Hz in the easy as compared to the hard condition. This suggests that the attentional window was wider in the easy condition.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1306

Spatial Heterogeneity for Attentional Capture Susceptibility

Poster Presentation - *Topic area: Attention: Space*

DONGYU GONG[1] (gdy17@mails.tsinghua.edu.cn), PEI SUN[1]; [1]Tsinghua University

Recent studies have shown spatial heterogeneity in the perception of multiple feature dimensions (Afraz, Pashkam, & Cavanagh, 2010), and also stable individual biases in object localization (Kosovicheva & Whitney, 2017). Considering the role of selective attention in visual perception (Boynton, 2005; Luck & Ford, 1998), we hypothesized that attentional capture would also exhibit spatial heterogeneity across display locations. In 3 experiments, we used modified versions of the additional singleton paradigm (Theeuwes, 1991, 1992) to test this hypothesis. In Experiment 1, distractors were defined on the color dimension. We tuned the relative saliency of the only color singleton into 5 levels using a linear interpolation method. A vertical segment or a horizontal segment was contained within the target form singleton, which appeared equally-often at each of the eight locations. After the location of the target was set, the color distractor appeared equally-often at the other seven locations. In Experiment 2 and 3, distractors were defined on the orientation and size dimension respectively. The five distractor saliency

conditions were specified by the relative inclination of the line segment contained within one of the non-target stimuli in Experiment 2, and by the relative size of one of the non-target stimuli in Experiment 3. The results showed a unique spatial distractibility pattern for each participant, with RT (reaction time) at some display locations demonstrating significant differences between distractor-present and distractor-absent conditions while some not. The stability and distinctiveness of spatial heterogeneity for attentional capture susceptibility for each participant were demonstrated by the high within-individual effect size correlation between 2 rounds and the low between-individual effect size correlation across display locations. These findings suggest that stimuli displayed at some spatial locations seem to be intrinsically easier to capture attention, which offers further insights for understanding the relationship between visual attention and perception.

Acknowledgements: This research is supported by Tsinghua University Initiative Scientific Research Program and Spark Innovative Talent Cultivation Program.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hi there! Welcome to my poster! Check my ResearchGate profile (https://www.researchgate.net/profile/Dongyu_Gong) for more information about my research. Dongyu

Abstract ID: 1678

Spatial attentional learning in simulated central vision loss

Poster Presentation - *Topic area: Attention: Space*

Douglas A Addleman[1] (addle005@umn.edu), Gordon E Legge[1], Yuhong V Jiang[1]; [1]University of Minnesota

Central vision loss disrupts patterns of eye movements during visual search due to the strong habit to fixate using the fovea. We investigated the effect of central vision loss on spatial attentional learning by simulating a scotoma in participants searching for a target that frequently appeared in one visual quadrant. Attentional biases may arise from an oculomotor habit to fixate that quadrant, in which case central vision loss may disrupt learning. Alternatively, if attentional learning relies on spatial representations not tied to oculomotor control, it may be unaffected by central vision loss. To dissociate these possibilities, we used a gaze-contingent paradigm to simulate a central scotoma 7º in radius during a location probability cueing task. Participants in Experiment 1 completed a two-phase T-among-L search task designed to induce attentional learning. In a training phase with simulated central vision loss, targets occurred in one screen quadrant with 50% probability. Despite the central scotoma, participants acquired location probability learning, responding faster and more accurately when targets appeared in the high probability quadrant

compared with other quadrants. In a testing phase, targets appeared equally often in each location and participants searched with and without the scotoma in alternating blocks. Despite different eye movement patterns with and without the scotoma, the training effect persisted to the testing phase for both viewing conditions. Experiment 2 investigated whether learning with healthy vision transfers to a testing phase with central vision loss. This experiment was identical to Experiment 1, except the training phase did not include a scotoma. Learning acquired with healthy vision persisted to the testing phase whether participants searched with or without the scotoma. Overall, location probability learning is present during simulated central vision loss, suggesting that the acquisition of spatial attentional learning may not require healthy eye movement patterns.

Acknowledgements: This work was supported in part by NSF Grant DGE-1734815, a University of Minnesota College of Liberal Arts Doctoral Dissertation Fellowship, and the University of Minnesota Engdahl Research Fund.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Thanks for your interest in my work! If you have questions or want to hear more, feel free to stop by any of my Zoom conference times or contact me via email at daddleman@dartmouth.edu or on Twitter @dougaddleman.

Abstract ID: 577

Top-down and stimulus-driven influences jointly determine precision of spatial attention

Poster Presentation - *Topic area: Attention: Space*

Sunyoung Park[1], John Serences[1,2,3]; [1]Department of Psychology, University of California, San Diego, [2]Neurosciences Graduate Program, University of California, San Diego, [3]Kavli Foundation for the Brain and Mind, University of California, San Diego

Spatial attention can target specific locations in the visual field to enhance processing of stimuli within that location. The top-down control of spatial attention is thought to be mediated via signals projecting from prefrontal cortex (PFC) to areas of early visual cortex. However, PFC neurons typically have relatively large spatial receptive fields and thus it is not clear how they guide highly precise attentional modulations in early visual areas. Here, we used fMRI to test the hypothesis that broad top-down spatial attentional

signals only achieve high precision after being combined with precise bottom-up stimulus drive (N=5, two sessions per subject). On each trial, subjects were briefly shown (500ms) either a "focused" or a "diffuse" attention cue indicating the possible location of a subsequently presented target. The target was an orientated Gabor rendered at one of 5 contrasts between 0-50% that was flashed briefly (150ms) at one of 12 equidistant locations in the periphery. The cue and the target were separated by dynamic filtered noise presented across all 12 target locations, over a variable delay period (2 or 6-8s), and the contrast of the filtered noise matched that of the target to provide variable amounts of bottom-up sensory drive. Subjects reported whether the orientation of the Gabor was closer to horizontal or vertical. The fMRI results show that the average univariate responses increased with higher contrast, but that the fidelity of multivariate representations for spatial positions stayed largely constant across contrast levels. These results place constraints on possible interactions between top-down and stimulus driven signals in determining the size and specificity of attentional modulations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 978

Training Multiple Object Awareness (MOA)

Poster Presentation - *Topic area: Attention: Space*

Farahnaz Wick[1] (farahnaz@gmail.com), Chia-Chien Wu[1], Devrath Iyer[2], Jeremy Wolfe[1]; [1]BWH/Harvard Medical School, [2]Hamilton High School

In classic Multiple Object Tracking and Multiple Identity Tracking (MOT, MIT), observers attempt to track N of M identical or unique items respectively as they move around a display. Typical tracking capacity is 2-4 items. Noting that we usually seem to know about the location and identity of more than 2-4 items in the world, Wu and Wolfe (2018) introduced the Multiple Object Awareness (MOA) paradigm. In MOA, observers are asked to track all unique items on screen. Like MIT, when items are occluded, observers are asked to localize one randomly selected item. Unlike MIT, if the first answer is wrong, observers keep clicking on locations until they find the target. If they were guessing, observers would need to click on half of the locations on average. However, they are not guessing. They have imperfect, but real knowledge about multiple items. From the distribution of clicks, it is possible to derive a capacity, based on this partial knowledge. This yields much larger estimates of 8-10 items. Is MOA capacity trainable and, if so, is any

improvement distinct from improvements in classic tracking capacity? Five observers were trained for two hours per day for 10 days within three weeks. Observers tracked 16 unique items. Items were from three categories: animals, tools and food. After 7-20 seconds all items were occluded. Observers were asked to locate one specific item. Data consists of the number of clicks required to uncover the target. Three observers significantly improved from capacity of 8.3 to 11.5 items (averaged over final three sessions). Two observers started poorly and got worse (capacity 0-3 items). MIT capacity improved proportionally suggesting that this improvement may not be MOA specific training. Future research will determine if the stark differences between learners and non-learners reflect “real” individual differences or merely badly behaved observers.

Acknowledgements: Supported by NSF 1848783 and the HMS.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 399

Using Attentional Modulation of the Pupillary Light Response to Study the Mechanisms Underlying Object-Based Attention.

Poster Presentation - *Topic area: Attention: Space*

Felipe Luzardo[1] (felipedavidluzardo@gmail.com), Wolfgang Einhäuser[2], Yaffa Yeshurun[1]; [1]University of Haifa, [2]Physics of Cognition Group, Chemnitz University of Technology

When an attentional precue is presented at one location of an object followed by a target at a different location, reaction times are faster if the precue and target are on the same object than if they appear on different objects. Three different explanations were offered to account for this object-based advantage: attentional spreading, attentional prioritization, and attentional shifting. Here, we used attentional modulations of the pupillary light response to test these explanations. In Experiment 1, we presented two rectangles composed of a luminance gradient. The gradient ranged from white to gray in one rectangle and from black to gray in the other. The attentional precue always appeared at the gray end of one of the rectangles. If attention spreads from the cued location to the rest of the object (attentional spreading) the pupil should dilate when the precue appears on the gray-to-black rectangle and constrict when the precue appears on the gray-to-white rectangle. In Experiment 2, a single rectangle was presented on a gray background. The rectangle was either black or white. A precue appeared at one end of the rectangle or in a

location outside the rectangle. The target could appear in the same location as the precue or in a different location – inside or outside the rectangle. If disengaging attention from a location inside the object is indeed slower than disengaging attention from a location outside the object (attentional shifting) then changes in pupil size should start later when the precue appears inside the rectangle while the target appears outside the rectangle. The pattern of results followed the attentional spreading account in Experiment 1, and the attentional shifting account in Experiment 2. This suggests that both mechanisms contribute to object-based effects.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1215

Attention: Time

Comparing mind-control in motion pareidolia with other ambiguous motion stimuli

Poster Presentation - *Topic area: Attention: Time*

Allison K. Allen[1] (alkallen@ucsc.edu), Nicolas Davidenko[1], Matthew T. Jacobs[1], Samrawit T. Ayele[1]; [1]University of California, Santa Cruz

Davidenko and colleagues (Davidenko, Heller, Cheong, & Smith, 2017) reported a new illusion, illusory apparent motion (IAM), in which randomly refreshing (1-3Hz) pixel arrays can elicit percepts of globally coherent motion moving in any number of directions (diagonal, rotating, etc.). In a recent study, we found that even with the many possibilities for disambiguating IAM, participants can mentally control their motion percepts (Allen, Jacobs, Panda, Carroll, Spears, Chen, & Davidenko, 2019) as has been shown in simpler ambiguous motion stimuli before (e.g., Kohler, Haddad, Singer, & Muckli, 2008). This finding led to two questions: (1) Is the ability to mentally control one's percepts consistent across different ambiguous motion stimuli? and (2) Is it harder for participants to mentally control IAM compared to apparent motion quartets (AMQ), given that IAM affords many possible interpretations? To address these questions, the current study compared mental control of ambiguous motion across four different stimuli: IAM, AMQ, a structure-from-motion cylinder, and a rotating Necker cube. Participants first completed a baseline block where they continuously reported the direction of motion they perceived during 30-second trials of each of

the four stimuli. Then, participants completed a second block where they were instructed to mentally hold a specified motion direction or change between two motion directions as quickly as possible. Results comparing average “change times” across 30 participants showed a correlation between IAM and the SFM cylinder. Average “hold times” showed correlations between IAM and AMQ, IAM and the SFM cylinder, and AMQ and the SFM cylinder. In addition, average times for IAM and AMQ were very similar across both hold and change trials. These results suggest that mental control in IAM shares common mechanisms with other ambiguous motion stimuli despite the added complexity of IAM stimuli.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York

Presenter's Message

Feel free to contact me: alkallen@ucsc.edu

Abstract ID: 1716

Cyclic Variability In Object and Spatial Attention

Poster Presentation - *Topic area: Attention: Time*

Subhosit Ray[1] (rays2016@fau.edu), Edward Ester[1]; [1]Florida Atlantic University

Selective attention can be directed to locations, objects, or features. A large and growing literature – drawing on results from psychophysics and electrophysiology – suggests that the benefits of attention wax and wane over short time scales (e.g., several cycles per second). However, it is unclear whether different modes of attentional selection share similar temporal profiles. The work presented here was designed to address this question. In Experiment 1, participants performed a data-limited variant of the classic Egly, Driver, and Rafal (1994) object-based attention paradigm. Briefly, participants were shown two horizontally or vertically arranged rectangles and cued to the likely position of a peri-threshold target at one end of one rectangle. During invalid trials, the target could appear at the wrong end of the cued rectangle (same-object condition) or at the same end of the non-cued rectangle (different-object condition). To measure the temporal dynamics of object-based attention benefits, we systematically varied the stimulus onset asynchrony (SOA) between the cue and target, then plotted participants’ target detection performance as a function of SOA. Experiment 2 was identical to Experiment 1, with the exception that the two rectangles were replaced with four squares to mimic classic spatial attention paradigms (e.g., Posner, 1980) while eliminating object-based attention effects. In both experiments, we found that the benefits of selective attention varied over short time scales in the theta band (3-5 Hz). These results imply that different modes of selective attention rely on a common rhythmic mechanism.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 409

Distinct temporal dynamics of sustained and spatial attention

Poster Presentation - *Topic area: Attention: Time*

Megan deBettencourt[1] (debetten@uchicago.edu), Edward Vogel[1], Edward Awh[1]; [1]University of Chicago

In daily life, our attention waxes and wanes despite our best efforts. Previous work has identified neural and behavioral signatures that track the dynamics of sustained attention (e.g., deBettencourt et al., Nat. Neurosci., 2015 & deBettencourt et al., Nat. Hum. Behav., 2019). For example, faster prepotent responses and lower multivariate decoding index worse attentional states. However, these studies have not examined how fluctuations of sustained attention interact with covert spatial attention. Either, sustained and spatial attention could covary synchronously or they could fluctuate independently. The goal of this study was to investigate the relationship between neural signatures of sustained and spatial attention using EEG. In this study, we presented participants with streams of rapidly appearing shapes in four quadrants on the screen. We manipulated spatial attention by cueing participants to covertly attend to one of the four quadrants and perform a visual sustained attention to response task (SART). Participants categorized whether the shapes in the cued location were circles or squares, and we manipulated the prepotent response (e.g., 85% circles vs. 15% squares). We verified that this task captured key behavioral signatures of sustained attention. Namely, participates made many more errors to the infrequent lure trials (i.e., squares) and faster prepotent responses preceded sustained attention lapses. Using multivariate pattern analysis of EEG data, we decoded sustained attentional state as well as the spatially attended quadrant. Intriguingly, even during moments of poor sustained attention, multivariate decoding of spatial attention was unimpaired. These results suggest sustained attention can wax and wane independently from spatial attention. This work provides new evidence that sustained and spatial attention are distinct, and provides important evidence to situate sustained attention in the broader attention taxonomy.

Acknowledgements: R01MH087214, ONR N00014-12-1-0972, F32MH115597

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 830

Does exogenously narrowing attention improve or impair temporal resolution?

Poster Presentation - *Topic area: Attention: Time*

Rebecca Lawrence[1] (rebecca.lawrence@utoronto.ca), Stephanie Goodhew[2], Mark Edwards[2], Jay Pratt[1]; [1]University of Toronto, [2]The Australian National University

Everyday life necessitates the efficient use of spatial attention, where one might broaden or narrow attention relative to task demands. For example, when driving, an individual is likely to spread attention broadly to scan and detect potential hazards. However, if brake lights suddenly flash in front of the driver, attention might be automatically narrowed to the car immediately ahead of them. The current study aimed to test the effect of automatically narrowing or broadening attention on temporal resolution: the ability to detect rapid temporal changes in the visual environment, such as a flickering light. Attention was manipulated using a peripheral cueing task, where lines of differing lengths were briefly presented to the left or right of fixation to automatically capture and scale attention. Following this, a small grey ring was presented at one of eight locations in the visual field, and participants decided whether or not the ring flickered. Critically, the size and location of the cues did not predict the upcoming location of the target. Thus, unlike past research, we ensured that attention was oriented in a true exogenous manner in response to the cues. Overall, we observed a main effect of cue location and a main effect of cue size on performance. Specifically, temporal resolution was worse for cued compared to uncued target locations as well as for small- compared to large-sized cues. Simply put, perception was worst at the most spatially-restricted cued location. This counterintuitive finding is important as it suggests that the automatic narrow focusing of attention at a location in the visual field, such as in response to the sudden flashing of a car's brake lights, is detrimental for some temporal aspects of visual perception.

Acknowledgements: This research is supported by an NSERC grant awarded to J.P (2016-06359), an Australian Research Council (ARC) Future Fellowship (FT170100021) awarded to S.C.G., and an ARC Discovery Project Awarded to M.E. (DP190103103)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 219

Exogenous Attention and Inhibition of Return in the Foveola

Poster Presentation - *Topic area: Attention: Time*

Yue Zhang[1] (zhangyue971024@gmail.com), Natalya Shelchkova[1], Rania Ezzo[2], Martina Poletti[1]; [1]University of Rochester, [2]Massachusetts General Hospital

The effects of exogenous attention in the visual periphery have been studied extensively. Yet, it is not well-known if this type of attention can be fine-tuned in the foveola, the 1-degree foveal region where visual resolution is the highest. Here, we addressed this issue by investigating the temporal dynamics of foveal inhibition of return. This phenomenon is typically associated with exogenous attention, and involves the suppression of a stimulus that had been recently attended to. A classic spatial cueing paradigm was used. The entire stimulus array was scaled in size to fit within the 1-degree foveola. Observers (n=9) fixated on a central marker throughout the trial. After a brief exogenous cue, high-acuity stimuli, tiny bars tilted 45 degree, appeared at four locations 11’ away from the central marker. Following a variable inter-stimulus interval, a response cue appeared pointing to one location. Subjects were instructed to determine the orientation of the stimulus previously presented there. Trials had 50% probability of being valid, i.e., when the exogenous and response cue matched. To eliminate the confounding factor of fixational eye movements, which would otherwise shift the stimulus array on the fovea, we used retinal stabilization; we used retinal stabilization; the stimuli remained immobile on the retina, and only trials without microsaccades were selected for analysis. Our findings show that for shorter inter-stimulus intervals (~60 ms), subjects’ ability to discriminate fine details was enhanced at the attended location and reduced at the unattended locations (d’ difference between valid and invalid trials; 0.49, $p<0.01$). We also report a temporal modulation resembling inhibition of return, characterized by higher performance at the unattended locations with longer intervals (d’ difference between valid and invalid trials; -0.61, $p<0.01$). These results indicate that involuntary attention can be fine-tuned at the foveal scale, contributing to the enhancement of high-acuity vision.

Acknowledgements: BCS-1534932 and NIH R01 EY029788-01

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please email yzh191@u.rochester.edu

Abstract ID: 843

Neural dynamics of interrupting sustained spatial attention

Poster Presentation - *Topic area: Attention: Time*

Nicole Hakim[1] (nhakim@uchicago.edu), Edward Vogel[1], Edward Awh[1]; [1]University of Chicago

Sustained spatial attention allows us to selectively process visual information through prioritization of specific spatial locations. Here, we investigated the impact of task-irrelevant interruption on sustained spatial attention during maintenance. Previous work has suggested that even when reaction times are increased due to interruptions, spatial attention does not obligatorily shift to the position of those interruptions (Folk & Remington, 1998). Instead, they proposed that responses are slowed because the interruptions interfered with target processing, even though attention did not shift to the location of the interruptions (e.g., Becker, 2007). Previously, we found that irrelevant interruption onsets can disrupt EEG activity that tracks ongoing storage in visual working memory (VWM). Here, we examined whether those onsets also capture spatial attention precisely at the interruption's location, even when interruptions appeared well after attention was focused on the target locations. We used EEG to track covert attention while subjects stored information in VWM, either with or without the onset of an irrelevant interruption during the delay period. We tracked the moment-to-moment locus of covert spatial attention by applying an inverted spatial encoding model to the scalp topography of alpha-band (8-12 Hz) activity. Participants performed a color change detection task during which they remembered the color and location of one or two circles over a 1,500 ms delay. On 50% of trials, a task-irrelevant circle appeared 700 ms after the onset of the memoranda. When interruptions were not presented, alpha topography tracked the target locations throughout the delay. When an irrelevant interruption was presented, by contrast, the spatial representation of the target dissipated following interruption onset, and alpha-band activity subsequently began to track the location of the irrelevant interruption. Thus, spatial attention shifts in a sustained fashion towards the location of irrelevant interruption, even well after attention has been focused on distinct target locations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 438

Perceptual rhythms are driven by oscillations in visual precision

Poster Presentation - *Topic area: Attention: Time*

René Michel[1,2], Laura Dugué[3,4,5], Niko A. Busch[1,2]; [1]University of Muenster, Muenster, Germany, [2]Otto Creutzfeldt Center for Cognitive and Behavioral Neuroscience, Muenster, Germany, [3]CNRS (Integrative Neuroscience and Cognition Center, UMR 8002), Paris, France, [4]Université de Paris, Paris Descartes, Paris, France, [5]Institut Universitaire de France (IUF), Paris, France

Visual perception, experienced as a continuous flow, counterintuitively seems to rely on a discrete sampling mechanism. Accumulating evidence suggests that this sampling operates in an oscillatory fashion at a rate of ~ 10Hz (alpha rhythm), such that “perceptual snapshots” are taken at favorable phases of the rhythm. Less is known about the unfavorable phases of this rhythm: do they constitute gaps during which no information is sampled at all, or is information sampled with insufficient precision for the task at hand? Both alternatives lead to poor performance in simple detection and discrimination tasks, making them impossible to distinguish. By contrast, using continuous report paradigms allows estimating independent model parameters for the amount of guessing and precision. We used such a continuous report task in combination with Posner-like, exogenous (i.e. involuntary) attentional cueing. On each trial, participants reported the orientation of a Landolt ring target that was briefly flashed at one of 20 cue-target intervals spaced in steps of 41ms, covering a time window from 192 to 983ms. 3840 trials were collected for each participant (N=14) across 8 sessions. The distribution of errors in participants’ reports was fitted with Standard Mixture Models separately for each cue-target interval and separately for validly (target at the attended location) and invalidly cued trials (target at the unattended location, thus requiring reorienting). The resulting time courses of the model’s guessing and precision parameters were analyzed with a Fast Fourier Transform to identify significant rhythms. We found that in invalid trials, which required attentional reorienting, precision was modulated rhythmically at the alpha frequency (9.6Hz). This result indicates that perceptual rhythms reflect fluctuations in precision rather than a succession of snapshots and gaps.

Acknowledgements: This work was supported by ANR-DFG grants to LD (J18P08ANR00) and NAB (BU 2400/8-1).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Note:

Please also check the available video guide (incl. animations) for in-depth explanations of methods, modelling & results!

Contact:

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Abstract ID: 1164

Performance boost after eye blinks in object recognition tasks

Poster Presentation - *Topic area: Attention: Time*

Jit Wei Ang[1] (angjw.aaron@gmail.com), Gerrit Maus[1]; [1]Nanyang Technological University

Eye blinks occur at consistent time points and may indicate switches between large scale cortical networks, such as dorsal attention and default-mode networks (Nakano et al., 2013. PNAS 110(2), 702–706). This could presumably lead to a refresh of attention whenever the dorsal attention network is reactivated after a blink. Previously, Ang and Maus (VSS, 2018) tested the effect of blinks on visual attention performance with several rapid serial visual presentation (RSVP) tasks. Participants had to identify a target embedded in a random stream of distractors, presented for 60 ms each. Participants (N = 40) blinked once during the presentation stream. In a separate condition, blinks were simulated by shutter glasses. They found enhancements of performance (up to 15%-point increase in accuracy) for targets appearing up to 270 ms after eyeblinks. This was replicated for object recognition with naturalistic stimuli but not in a numerosity task and spatially distributed stimuli. Here, we followed up the study to address several concerns. We 1) completely randomised the target to appear anywhere before and after an eye blink, 2) increased the sample size to N = 118, and 3) introduced an additional control condition in which participants triggered the shutter glasses manually. The results confirmed a sustained boost of perceptual performance after voluntary eye blinks as compared to artificial blinks. This further supports the notion that eye blinks have a cognitive and perceptual consequences over and above the brief disruption of the visual input.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

Do drop me an email at angj0055@e.ntu.edu.sg if you like to get in touch.

Abstract ID: 638

Voluntary temporal attention and MEG visual cortical responses

Poster Presentation - *Topic area: Attention: Time*

Rachel Denison[1] (rachel.denison@nyu.edu), Karen Tian[1], David Heeger[1], Marisa Carrasco[1]; [1]New York University

[Goal] Visual attention fluctuates across both space and time. Voluntary temporal attention is the goal-directed prioritization of visual information at specific points in time. Temporal attention selectively improves perceptual sensitivity at attended times. Here, we investigated the neural mechanisms underlying these perceptual improvements using MEG. We assessed how voluntary temporal attention affects the timing reliability of human visual cortical responses. [Methods] Observers performed an orientation discrimination task. On each trial, two grating targets (T1 and T2) appeared sequentially at the fovea for 50 ms, separated by a 300 ms stimulus onset asynchrony. A precue tone (75% validity) instructed observers to attend to T1 or T2. A response cue tone after the targets instructed them to report the orientation (CW/CCW) of either T1 or T2. Thus, on each trial, one target was attended and the other was unattended. The targets were embedded in 20 Hz flickering noise. The flicker generated a 20 Hz steady state visual evoked field (SSVEF) response in visual cortex, which served as a probe of visual cortical responses throughout the trial. We used a wavelet analysis to measure 20 Hz stimulus-locked oscillations across time. We calculated the intertrial phase coherence (ITPC) of the SSVEF signal, which indexes neural timing reliability. [Results and Conclusion] Temporal attention improved orientation discrimination performance, more for T1 than T2. Each target was followed by a brief change in ITPC, which we call the evoked ITPC response. Temporal attention increased the magnitude of the evoked ITPC response for T1 but not T2. In conclusion, voluntary temporal attention affected the timing reliability of the T1 response.

Acknowledgements: NIH NEI R01-EY019693, F32-EY025533

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 618

Attention: What is attended?

Both endogenous and exogenous temporal orienting trigger an attentional boost effect

Talk Presentation - *Topic area: Attention: What is attended?*

Caitlin A. Sisk[1] (siskx024@umn.edu), Yuhong V. Jiang[1]; [1]University of Minnesota

Increasing attention to one task typically interferes with performance on another. However, responding to targets in a continuous task paradoxically enhances memory for background scenes. This “attentional boost effect” reflects a transient increase in attention when target detection triggers a temporal orienting response. To date, researchers have primarily investigated the attentional boost effect under exogenous temporal orienting conditions, in which the targets are temporally unpredictable. Yet humans can endogenously orient to predictable moments as well. To understand how endogenous and exogenous temporal orienting affect concurrent task processing, we explored the interaction between temporal predictability and the attentional boost effect. Participants memorized a stream of scenes presented at 1s/scene, while concurrently monitoring a stream of digits for a target digit—the number 0 in Experiment 1, and 0 in a specific color (green or red) in Experiment 2. In half of the blocks, the appearance of the 0 was predicted by the preceding sequence 3, 2, 1. In the other half of the blocks, 0 could appear at any moment. Results from the unpredictable blocks replicated previous findings: participants showed better memory for scenes coinciding with the target 0 than with nontarget digits, and this boost was confined to 0 in the specified target color. When 0 was temporally predictable, participants still showed an attentional boost effect for scenes coinciding with the 0, and in contrast to predictable blocks, this effect extended to 0 in the nontarget color. Memory was not better for scenes coinciding with predictive digits. This suggests that regardless of whether an expected target appears, the boost from endogenous temporal orienting occurs at the moment to which one orients, rather than the moment of the predictive cue. This study provides insights into temporal orienting mechanisms, demonstrating that endogenous orienting, like exogenous orienting, triggers a transient boost in attentional resources.

Acknowledgements: National Science Foundation, University of Minnesota College of Liberal Arts

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

https://pubmed.ncbi.nlm.nih.gov/32271063/

Abstract ID: 1302

Direct Comparison of the Neural Correlates of Value- and Punishment-Driven Attentional Capture

Talk Presentation - *Topic area: Attention: What is attended?*

Haena Kim[1], Brian A. Anderson[2]; [1]Texas A&M University

Prior experience with reward and aversive outcomes influences the attentional system. Even when non-salient and task-irrelevant, stimuli associated with either a reward or an aversive outcome capture attention, with a similar behavioral profile, and there is evidence across studies for a common neural substrate. However, a direct comparison of the neural correlates of attentional capture by stimuli previously associated with reward and punishment is lacking. We directly compared the influence of reward and aversive outcomes on attention in an fMRI study using a combined general linear model (GLM) and multi-voxel pattern analysis (MVPA) approach. In a training phase, participants generated a speeded saccade to a square, the colour of which signalled either a reward (monetary gain), aversive (unavoidable electric shock), or no outcome (neutral). In a test phase, a square (distractor) and a circle (target) were presented simultaneously, one of which could appear in either the previously reward- or shock-associated colour. Participants had to fixate the circle. Behavioural data replicated attentional capture by both the reward- and shock-associated distractor, which was of comparable magnitude. Compared to neutral stimuli, both distractors were associated with overlapping stimulus-evoked activation in bilateral visual cortex, spatial priority maps (bilateral intraparietal sulcus and frontal eye field), regions previously linked to value-driven attention (caudate tail and substantia nigra), and regions of the ventral attention network (right middle frontal gyrus and temporo-parietal junction), among others. A direct comparison between distractor conditions revealed no significant clusters of differential activation. Furthermore, within the regions of common activation, the voxelwise pattern could not be reliably distinguished between the two distractor conditions; this was true both within individual regions as well as across regions. Altogether, these results suggest that the attentional system is guided by motivational relevance, with a common brain system for selecting stimuli on the basis of reward- and punishment-history.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 239

Dynamic spotlight model recovers the position but not the width of covert spatial attention

Talk Presentation - *Topic area: Attention: What is attended?*

Leah Bakst[1,2] (lbakst@bu.edu), Ilona Bloem[1,2], Joseph McGuire[1,2], Sam Ling[1,2]; [1]Department of Psychological and Brain Sciences, Boston University, [2]Center for Systems Neuroscience, Boston University

Covert attention has been shown to enhance both behavioral performance and corresponding visual signals in early visual cortices. Moreover, spatial uncertainty around the locus of attention appears to increase the width of the attentional field. However, we currently lack an efficient way to dynamically recover both the position and width of the attentional field from human brain data. In a series of tasks reliant on covert attention, observers were required to discriminate between letters and numbers embedded in a ring of dynamic noise. Observers were cued to attend to 1, 5, or 9 letters out of 20. To dynamically capture the position and width of the covert spotlight of attention, we fit a von Mises distribution to voxel BOLD responses in early visual cortex as a function of their receptive fields' angular position, for each individual time point. In the first task, observers had to determine whether a digit appeared in place of one letter in the cued area of the ring. This dynamic spotlight model recovered the position of observers' attentional fields at individual time points with high precision. However, no significant differences in the recovered width of the attentional field were associated with cued spatial uncertainty. In a second task, observers had to use spatial integration to determine whether there were more digits or letters in the cued area of the ring. The position of the attentional field was again recovered with high precision but, as before, there were no systematic differences in the width estimates. This suggests that covert attention enhances signaling in early visual cortex, but the manner in which spatial uncertainty interacts with this enhancement may not be as straightforward as previously thought.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 327

Flexible focus in feature-based attention: efficient tuning of attention to narrow and broad ranges of task-relevant feature values

Talk Presentation - *Topic area: Attention: What is attended?*

Angus F. Chapman[1], Viola S. Stoermer[1,2]; [1]Department of Psychology, University of California, San Diego, [2]Neurosciences Graduate Program, University of California, San Diego

Feature-based attention is the ability to select relevant information on the basis of visual features, such as a particular color or motion direction. While some research has proposed a fixed limit on attention to a single visual feature (e.g., Huang & Pashler, 2007), it is unknown whether feature-based attention can be tuned more narrowly or broadly across different feature values. Here we test the limits of feature-based selection by asking whether and to what extent different ranges of feature values can be efficiently attended. Across four experiments, we demonstrate that feature-based attention can be flexibly adjusted in response to current visual input. Participants were instructed to attend to a set of colored dots amongst a set of distractor dots to detect a brief luminance decrease. To vary attentional focus, we manipulated the range of target dot colors across six conditions (uniform distributions spanning 10°, 20°, 40°, 60°, 90°, or 120° in a luminance-matched CIELab space), and found consistent but surprisingly moderate reductions in performance as the range of target colors increased. In a second experiment, we replicated this finding in a 2-dimensional CIELab space, controlling for influences of target-distractor similarity between conditions. Additional experiments demonstrated that this effect could not be explained by participants simply attending to a subset of the target dots as the color range increased (Experiment 3 & 4). Our findings show that feature-based attention can be directed to different ranges of colors, suggesting a flexible focus of attention, analogous to findings in spatial attention. Whether these two modes reflect the same underlying processes (a "zoom-lens" for feature-based attention) remains to be determined. Exploration of the representational spaces that underlie attention to features and locations could further bridge the connection between these literatures and help sharpen our understanding of the common mechanisms that influence visual attention.

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 11:00 pm EDT America/New_York

Presenter's Message

You can access the video presentation on youtube too: https://www.youtube.com/watch?v=XMq3iT4fMuE

Abstract ID: 217

The effects of spatial attention on temporal integration measured with the Ternus display

Talk Presentation - *Topic area: Attention: What is attended?*

Ilanit Hochmitz[1] (ilanit57@gmail.com), Elisabeth Hein[2], Yaffa Yeshurun[1]; [1]University of Haifa, [2]University of Tübingen

Whilst a large body of evidence has demonstrated the effects of covert attention on spatial processes, much less is known about attentional effects on the complementary temporal aspects of visual perception. We examined the effects of spatial attention on temporal integration using the Ternus display. In a typical Ternus display horizontally aligned disks are shifted by one position across alternating frames that are separated by a varying inter-frame interval (IFI). This display can induce different motion percepts (element and group motion). Element-motion is thought to reflect temporal integration while group-motion reflects spatial integration. Experiments 1 and 2 employed peripheral presentation (5° eccentricity) of a typical Ternus- display with different attention manipulations. In Experiment 1 sustained attention was manipulated via the degree of certainty regarding the disks location. In the attended condition, the disks appeared always in the same location, and in the unattended condition they could appear in one of two possible locations. Observers indicated which motion they perceived. We found higher rates of element-motion reports in the attended condition than in the unattended condition, suggesting that sustained attention enhances temporal integration. In Experiment 2 a peripheral cue was used to generate transient spatial attention. We found no attentional effect on the Ternus motion percepts. In Experiment 3 we examined whether the lack of effect in Experiment 2 was due to unintended temporal interactions between cue related transients and the IFI manipulation. We used a modified Ternus display with no IFI manipulation and Gabor patches as elements. Temporal integration was manipulated by varying the elements' orientation similarity across display frames. The patches' orientation varied between the two frames from 0° to 45°. We found higher rates of element motion reports in the attended condition, suggesting that transient attention, like sustained attention, can enhance temporal integration.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1353

Binocular Vision

Adaptation to transient visual changes destabilizes the spatio-temporal dynamics of binocular rivalry

Talk Presentation - *Topic area: Binocular Vision*

Chris Paffen[1] (c.l.e.paffen@uu.nl), Sjoerd Stuit[1], Yentl de Kloe[1], Stefan van der Stigchel[1], Marnix Naber[1]; [1]Utrecht University & Helmholtz Institute

Binocular rivalry refers to perceived alternations between non-alternating, distinct images presented dichoptically. Recently, Said & Heeger (2016) showed that the incidence of intermixed percepts during binocular rivalry increased after prolonged viewing of (i.e. adaptation to) interocular conflict. They attributed this effect to the adaptation of conflict detectors, which would presumably drive binocular rivalry. Here we test an alternative explanation by asking to what degree adaptation to (perceived) transient changes affects the incidence of intermixed percepts during binocular rivalry. In three experiments, observers were adapted to stimuli in which the amount of (1) interocular conflict, (2) monocular changes in contrast, (3) monocular changes in orientation, and (4) perceived changes in orientation were systematically varied. The adaptation stimuli consisted of sinewave gratings which were phase-reversing at 0.94 Hz. On each trial, an observer would undergo 100 s of adaptation to the above variants of dichoptic displays, after which exclusive percepts as well as mixed percepts were reported in a 80 (Experiment 1) or 40 s (Experiments 2&3) test phase. Across the three experiments, the amount of exclusive percepts was influenced most by the amount of (1) monocular changes in contrast and of (2) perceived changes in orientation during adaptation. Interestingly, however, the amount of interocular conflict during the adaptation phase hardly affected subsequent reports of exclusive rivalry. The latter observation is further supported by a general linear model in which we incorporated our four principal variants during adaptation as factors: in this model the beta factor for interocular conflict was not significant. We conclude that (perceived) transient changes in the rivalling images and not the amount of interocular conflict affects the spatio-temporal dynamics of binocular rivalry.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 124

Amplification of feature selectivity by spatial convolution in primary visual cortex

Talk Presentation - *Topic area: Binocular Vision*

Felix Bartsch[1] (felixbartsch@gmail.com), Daniel A. Butts[1], Bruce Cumming[2]; [1]University of Maryland, [2]National Eye Institute

Primary visual cortex (V1) has long been of interest in the study of binocular integration, as it receives largely separate monocular streams of input, but its outputs are almost entirely binocular. Here we hypothesize that the selectivity of V1 neurons to binocular disparity (i.e. the difference is location of images between the two eyes) is derived through convolutional processing, which amplifies correlations present in natural binocular inputs. Most previous models of disparity selectivity within V1 are based on comparing similar spatiotemporal input from each eye (often displaced by the neuron's preferred disparity). Such processing, however, is limited in how much it can be modulated by disparity because its disparity selectivity is conflated with its sensitivity to the particular spatiotemporal patterns. Thus, performing identical binocular processing across space (i.e., performing a spatial convolution of binocular subunits) can leverage the correlations present in natural visual input: with disparity typically correlated over large spatial scales (due to the depth structure of the visual scene) and pattern information changing rapidly within these scales. The convolution thus amplifies the correlated disparity signals while averaging out their responses to particular patterns. We test such a model using recordings from V1 neurons in awake macaque, presenting random bar stimuli aligned to each neuron's receptive field with randomly changing disparity. Unlike previous models of V1 disparity tuning, our model is able to almost completely reproduce the disparity tuning of a wide variety of binocular V1 neurons to complex stimulus patterns: explaining, on average, >80% of the disparity selectivity of disparity-tuned V1 neurons, with many neurons almost perfectly explained. Furthermore, such a model also generalizes to non-disparity-tuned V1 cells. We thus suggest this as a general strategy for amplification of a feature selectivity within V1.

Acknowledgements: NEI/NIH EY025403; NSF DGE-1632976; Intramural research program at NEI/NIH

This talk will be presented in Live Talk Session 3, Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1344

Attention in rivalrous perception: novel insights from pupillometry

Talk Presentation - *Topic area: Binocular Vision*

Paola Binda[1] (paola1binda@gmail.com), Miriam Acquafredda[1], Claudia Lunghi[2]; [1]University of Pisa, [2]Laboratoire des systemes perceptifs, Departement d etudes cognitives, Ecole normale superieure, PSL University, UMR 8248 CNRS, 75005 Paris, France

In binocular and inter-ocular grouping (IOG) rivalry, perceptual alternations are generated by competition between eyes and between patterns. Existing models predict that competition occurs at different levels of the visual system for the two types of rivalry (monocular and binocular respectively), which may be differentially affected by top-down factors. To test this, we measured the effect of attention on the two types of rivalry and we applied pupillometry, which previous work suggests to reliably index both perceptual switches and attention shifts. 38 participants tracked the perceptual dynamics of binocular and IOG rivalry, while we measured pupil diameter with an Eyelink1000. Stimuli were 3-deg white or black disks, seen through a mirror stereoscope; for binocular rivalry, each eye saw one of the disks; for IOG rivalry, each eye saw a half-white half-black disk. Both types of rivalry were tested in three conditions: no-cue and black/white-cued, where attention was to be endogenously directed to the black/white disk. Perceptual reports indicate that endogenously directing attention to either percept produced the expected dominance increment. Unexpectedly, we find that the amount of modulation is the same for binocular and IOG rivalry. Pupil diameter reliably tracked the alternation of percepts in both types of rivalry, with a systematic pupil size difference between white- and black-disk dominant phases. However, this difference was not modulated by attention – implying that the bright/dark stimulus became no stronger (brighter/darker) when it was attended, yet it stood a better chance to win the competition for visual awareness. We conclude that attention biases the competition between eyes and between stimuli in a similar way - if these competitions occur at different stages, they are equally affected by attention. Pupillometry results indicate that, surprisingly, attention can bias the competition without affecting stimulus strength, confuting a key tenet in rivalry research.

Acknowledgements: This project has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (g.a. No 801715 - PUPILTRAITS) and by the French National Research Agency (ANR), AAPG 2019 JCJC (g.a. ANR-19-CE28-0008, PlaStiC).

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 702

Binocular Lustre: Does identification of interocular contrast difference require opposite (light-dark) contrasts in the two eyes?

Talk Presentation - *Topic area: Binocular Vision*

Frederick Kingdom[1] (fred.kingdom@mcgill.ca), Hiromi Sato[2], Ronald Chang[3], Mark Georgeson[4];
[1]Department of Ophthalmology, McGill University, [2]University of Tokyo, [3]Department of Psychology, McGill University, [4]School of Life & Health Sciences, Aston University,

Interocular (between-eye) differences in contrast elicit an impression of lustre, a cue to their identification. Recent models of binocular interaction have suggested that interocular differences are easiest to detect if the two eyes' contrasts are of opposite polarity. We tested this by measuring thresholds for contrast detection, and identification of interocular differences, using circular patches that comprised various interocular combinations of luminance increments (INC), decrements (DEC) or blanks (NONE). In left-eye to right-eye order, our stimulus combinations were both unipolar, i.e. INC-NONE, NONE-INC, DEC-NONE, NONE-DEC, INC-INC, DEC-DEC, and bipolar, i.e. INC-DEC and DEC-INC. In the detection task subjects had to decide whether the stimulus was above or below fixation. In the identification task subjects had to decide whether the stimulus (also above or below fixation) contained an interocular difference or not. When contrast in the identification task was defined as the interocular difference in contrast (i.e. INC-DEC had twice the contrast difference of INC-NONE) and was normalised to detection threshold, bipolar contrast differences were on average only slightly more easily identified than unipolar contrast differences. This suggests that detection of dichoptic contrast difference does not depend crucially on having opposite, light-dark, polarities in the two eyes. We found that a model comprising four channels: left eye (L), right-eye (R), binocular sum (B+) and binocular difference (B-), gave a good account of the data when thresholds were determined by the channel giving the biggest response (the MAX rule). For the identification task, the B+ and B- channels were subject to greater noise than in the detection task. In this sense identification was a little more 'difficult' than detection.

Acknowledgements: Canadian Institute of Health #MOP 123349 too F.K. Leverhulme Trust (EM-2017-097) grant to M.A.G.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 257

Intracranial recordings reveal unique shape and timing of responses in human visual cortex during illusory visual events

Talk Presentation - *Topic area: Binocular Vision*

Maartje Cathelijne de Jong[1,2,3] (dejongmc@gmail.com), Mariska J. Vansteensel[4], Raymond van Ee[5,6,7], Frans S. S. Leijten[4], Nick F. Ramsey[4], H. Chris Dijkerman[8], Serge O. Dumoulin[1,3,8], Tomas Knapen[1,3]; [1]Spinoza Centre for Neuroimaging, Amsterdam, The Netherlands, [2]University of Amsterdam, Dept. of Psychology, Amsterdam, the Netherlands, [3]Experimental and Applied Psychology, VU University, Amsterdam, The Netherlands, [4]UMC Utrecht Brain Center, Dept. of Neurology and Neurosurgery, University Medical Center Utrecht, The Netherlands, [5]Philips Research Laboratories, Department of Brain, Behavior and Cognition, Eindhoven, The Netherlands., [6]Experimental Psychology, University of Leuven, Leuven, Belgium., [7]Donders Institute, Radboud University, Department of Biophysics, Nijmegen, The Netherlands., [8]Experimental Psychology, Helmholtz Institute, Utrecht University, Utrecht, the Netherlands.

During binocular rivalry perception spontaneously changes without any alteration to the visual stimulus. What neural events bring about this illusion that a constant stimulus is changing? We recorded from intracranial electrodes placed on the occipital and posterior temporal cortex of two patients with epilepsy, while they experienced illusory changes of a face-house binocular-rivalry stimulus, or observed a control stimulus that physically changed. We performed within-patient comparisons of broadband high-frequency responses, focusing on single epochs recorded along the ventral processing stream. We found transient face- and house-selective responses localized to the same electrodes for illusory and physical changes, but the temporal characteristics of these responses markedly differed. In comparison with physical changes, responses to illusory changes were longer-lasting, in particular exhibiting a characteristic slow rise. Furthermore, the temporal order of responses across the visual hierarchy was inverted for illusory as compared to physical changes: for illusory changes higher-order fusiform regions responded before lower-order occipital regions. These findings suggest that two stages underlie the initiation of illusory changes: a destabilization stage in which activity associated with the impending change gradually accumulates across the visual hierarchy, ultimately graduating in a top-down cascade of activity that may stabilize the new perceptual interpretation of the stimulus.

Acknowledgements: This work was supported by NWO-CAS grant 012.200.012 awarded to TK, ABMP grant 2015-7 awarded to TK, an Ammodo KNAW Award awarded to SOD and NWO-VICI grant 016.Vici.185.050 awarded to SOD.

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

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publication of this project: De Jong et al., 2020, Current Biology [in press]

Abstract ID: 375

Sensitivity vs. awareness curve: a novel model-based analysis to uncover the processes underlying nonconscious perception

Talk Presentation - *Topic area: Binocular Vision*

Fabian Soto[1] (fasoto@fiu.edu), Ali Pournaghdali[1]; [1]Florida International University

We present a novel model-based analysis of the association between awareness and perceptual processing based on a multidimensional version of signal detection theory (general recognition theory, or GRT). The analysis fits a GRT model to behavioral data and uses the estimated model to construct a sensitivity vs. awareness (SvA) curve, representing sensitivity in the discrimination task at each value of relative likelihood of awareness. This approach treats awareness as a continuum rather than a dichotomy, but also provides an objective benchmark for low likelihood of awareness, at the point in which an ideal observer would categorize a perceptual effect as resulting from no stimulus. Confidence intervals are built for the SvA curve using parametric bootstrapping, so that conclusions about the relation of perceptual processing and awareness can be reached by simple visual inspection. In two experiments, we assessed nonconscious facial expression recognition using SvA curves in a condition in which emotional faces (fearful vs. neutral) were rendered invisible using continuous flash suppression (CFS) for 500 (Experiment 1) and 700 (Experiment 2) milliseconds. Participants had to provide subjective awareness reports, expression discrimination responses, and meta-cognitive judgements of confidence on those discrimination responses. We predicted and found sub-conscious processing of face emotion, in the form of higher than chance-level sensitivity in the area of low likelihood of awareness. We also found evidence for meta-cognitive sensitivity in the absence of awareness. The similarity between the pattern of results from perceptual discrimination and metacognitive judgements is in line with the detection-theoretic assumption that both processes are based

on the same perceptual evidence variable. More generally, the SvA curve analysis can be applied to a variety of designs to answer questions about the dependence of perceptual processing on awareness, and is easily available as part of an R package.

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

You can download a preprint describing this research from the following link: https://psyarxiv.com/akem2

Contact me to fasoto@fiu.edu if you have any questions or you want to get the code to run an SvA curve analysis.

Abstract ID: 959

Binocular Vision: Models and mechanisms

A phase-disparity model for vergence eye-movements

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Jian Ding[1] (jian.ding@berkeley.edu), Dennis M. Levi[1]; [1]School of Optometry, University of California, Berkeley

Binocular fusion requires a vergence mechanism to bring the two eyes' images into alignment. To determine the accuracy of vergence we measured Nonius alignment under a range of viewing conditions. Specifically, we presented random-Gabor-patch (RGP) stereograms (14deg x 14 deg) for 400ms, followed 100ms later by two briefly presented (100ms) vertical Nonius lines. Participants judged the relative position of the Nonius lines to provide a psychophysical estimate of the vergence induced by the preceding RGP stereogram. The RGP stereograms consisted of vertical Gabor patches with random positions and phases, but with fixed spatial frequencies (1.5, 3.0 or 6.0 cpd). Identical arrays of patches were presented to the two eyes, except that one eye's array could be shifted horizontally to produce binocular disparity, with either correlated or anti-correlated luminance profiles. For each spatial frequency, 38 staircases, one for each of the 19 stimulus disparities x 2 correlation conditions, were interleaved. For both correlated and anti-correlated conditions, the vergence shift first increased with stimulus disparity, reaching a maximum

when disparity was 2-4 times the Gabor wavelength, and then decreased. We implemented and tested a binocular motor fusion model that assumes that vergence is driven by phase-disparity energy under a coarse-to-fine process to align the two eyes images until phase disparity is eliminated. Our modeling shows that a simple model with a single second-order phase-disparity detector with a spatial wavelength of 8-16 times the Gabor wavelength, provides a reasonable fit to both correlation conditions. Adding another second-order phase-disparity detector with a shorter spatial wavelength might significantly improve the model fits. Adding a first-order phase-disparity detector further improved the model fits significantly, providing a reasonable account of the differences between the two correlation conditions. We conclude that vergence eye movements are driven by multiple pathways at different scales, mainly by second-order phase-disparity energy.

Acknowledgements: NIH RO1EY020976

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 593

Cortical and subcortical dynamics during binocular rivalry

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Irem Yildirim[1] (yildirim@udel.edu), Keith A. Schneider[1]; [1]University of Delaware

Binocular rivalry occurs when the two eyes are presented with conflicting stimuli. These stimuli compete for perception such that the observer can only perceive one stimulus at a time. We sought to measure the interplay among visual cortex and subcortical nuclei in humans during binocular rivalry to better understand the control mechanism driving our visual perception. We were particularly interested in the superior colliculus (SC) and the magno- (M) and parvocellular (P) segments of lateral geniculate nucleus (LGN). Four subjects participated in the study. The subjects wore circularly polarized 3D-glasses while viewing a visual stimulus presented by a ProPixx projector with a synchronized polarizing shutter, allowing dichoptic presentation. In two separate sessions, subjects were scanned with a 3T MRI scanner for ten five-minute runs, using a multiband EPI sequence with 1.5mm isotopic resolution for the whole brain, with a TR of 1.5s. The stimuli were two superimposed monochromatic sinusoidal gratings that rotated in opposite directions, with a period of 1s. Subjects held down a button to indicate which direction of rotation they perceived at the time. In a replay condition, the subjects' responses from their previous rivalry block were

used to mimic their perceptions, presenting a mixture when subjects reported piecemeal rivalry. In a third scanning session, we acquired 40 proton density weighted images with 1mm isotropic resolution covering the thalamus and midbrain, to aid in anatomical segmentation of the subcortical nuclei. V1 and medial temporal areas were significantly active in rivalry and replay conditions. Parietal lobe activation, however, was significantly stronger for rivalry than replay. SC was found to be differentially activated in rivalry and replay conditions but the activity in the M and P layers of LGN did not differ. These results indicate a role of attention as well as the involvement of transient and sustained visual processing.

Acknowledgements: NIH/NEI 1R01EY028266. “Directly testing the magnocellular hypothesis of dyslexia”

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 789

Ideal Observers for the Estimation of Disparity in Random-Pixel Stereograms

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Can Oluk[1] (coluk@utexas.edu), Wilson S. Geisler[1]; [1]University of Texas at Austin

Random-pixel stereograms (Julesz, 1960) are routinely used to isolate and study the binocular mechanisms of 3D perception. These stereograms consist of textures where the pixels have gray levels that are statistically independent and identically distributed (IID textures). Typically, the distributions are either Bernoulli (binary) or Gaussian. We derived the ideal observers for these two cases, where the task is to estimate the absolute disparity when the IID texture is a different unknown random sample on each trial, and where “internal noise” is represented by adding some level of independent Gaussian pixel noise that is uncorrelated in the left and right images. The parameters of the IID probability distribution, the standard deviation of internal noise, and the prior over disparity were assumed to be known to the observer. We compared the performance of the ideal observer with three standard computational observers: cross-correlation (CC), squared error (SE), and normalized cross-correlation (NCC). Simulations show that the NCC observer generally performs better than the CC observer and slightly better than the SE observer. Furthermore, the NCC observer closely approximates the ideal observer if the local patch is sufficiently big. The NCC observer more closely approximates the ideal observer for the IID Gaussian texture than for the

IID Bernoulli texture. The overall conclusion is that the NCC observer generally performs close to the ideal observer. Code and demonstrations can be found here: https://github.com/CanOluk/OptimalDisparityEstimation.

Acknowledgements: NIH grant EY11747

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 578

Measuring Transitory Modulation of GABA Levels in the Visual Cortex

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Yeo Bi Choi[1] (yeo.bi.choi.gr@dartmouth.edu), Adam Steel[1], Thomas Botch[1], Caroline Robertson[1]; [1]Dartmouth College

Introduction: Binocular rivalry is thought to rely on the balance of excitatory and inhibitory neurotransmission in the visual cortex. Using Magnetic Resonance Spectroscopy (MRS), we have previously linked rivalry dynamics to excitatory (glutamate-glutamine; glx) and inhibitory (gamma-aminobutyric-acid; GABA) levels in the visual cortex in a trait-dependent manner (i.e. individuals with higher visual cortex GABA levels show greater perceptual suppression during rivalry; Robertson et al., 2016). Here, we sought to understand this link in a state-dependent manner (i.e. the tie between rivalry and transient GABA level changes) in vivo using functional magnetic resonance spectroscopy (f-MRS). Methods: We acquired visual cortex GABA and Glx concentrations using a MEGA-PRESS sequence at 3T while participants (n=8) viewed alternating blocks (24s each, 6s ISI, 256 spectra total) of rivalry stimuli (orthogonal gratings, one presented to each eye) or fused stimuli (plaids, both presented to each eye). Participants were asked to indicate which stimulus they were seeing using a button press. Individual spectral acquisitions were aligned and averaged by condition (rivalry/harmony). Results: Contrary to our hypothesis that GABA levels would be higher during rivalry as compared with fusion blocks, we found no significant difference across conditions. None of the between condition differences in the measurement of GABA (p=0.1144), Glx (p=0.3037) and the ratio of the two (p=0.7295) were significantly different from zero (Figure 1). Conclusion: In sum, we examined the underlying neurometabolic concentration of binocular rivalry fluctuations at a higher temporal resolution using a block design. Current results show no relation between transient GABA levels in the visual cortex and behavioral measure of rivalry. Future studies are needed to better understand the temporal dynamics of functionally-driven changes in neurotransmitter levels using MRS.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 598

Neural evidence for multiple spatio-temporal channels underlying human disparity sensitivity

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Milena Kaestner[1] (milenak@stanford.edu), Marissa L. Evans[1], Yulan D. Chen[2], Anthony M. Norcia[1]; [1]Stanford University, [2]Northwestern University

Similar to contrast, disparity sensitivity varies as a function of spatial frequency. The psychophysical ‘disparity sensitivity function’ peaks around 0.5cpd but drops off for low and high frequency disparity-defined gratings. Behavioural measures have described its shape as the envelope of at least two spatial frequency channels, but a linkage to possible temporal channels has not been established. We reconstructed the disparity sensitivity function from a neural readout, measuring steady-state visual evoked potentials in normally-sighted individuals (N=25). Stimuli were dynamic random dot stereograms alternating at 2Hz between a flat plane at zero disparity, and a crossed-disparity sine-wave grating increasing in disparity amplitude. Gratings of seven different spatial frequencies were shown (0.1 - 2cpd), with an additional absolute disparity condition. We applied reliable component analysis to identify cortical sources that responded in a consistent manner across trials, revealing two primary components. The first was focused over the occipital pole and the second was right-lateralized over extrastriate cortex. Across both components, the first harmonic was strongly tuned for spatial frequency, where the magnitude of the response depended both on the stimulus disparity amplitude and its spatial frequency. The characteristic U-shaped disparity sensitivity function was mirrored by responses in the occipital 1f1 component. We suggest this response harmonic captures the dynamics of a sustained relative disparity mechanism. In contrast, the second harmonic was invariant across spatial frequency. Responses were generally weaker to all stimuli except the absolute disparity stimulus. Responses to a flat plane oscillating in depth were best captured by the occipital source, suggesting an early, transient absolute disparity mechanism. Our electrophysiological approach revealed at least two parallel mechanisms differing in their spatio-temporal tuning, adding a further dimension to the current description of the spatial frequency channels thought to underlie disparity processing.

Acknowledgements: Grant number EY018875 from the National Eye Institute, National Institutes of Health (awarded to AMN)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 857

Precision and Repeatability of a Dichoptic Localization Paradigm Designed to Measure Aniseikonia

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Marianna Butera[1] (mbutera@sunyopt.edu), Alina Sample[1], Jeffrey LeBlanc[1], Kevin Willeford[1]; [1]SUNY College of Optometry

Asthenopia is common in patients with aniseikonia, a clinical condition in which the spatial localization of objects differs between each eye. There is intra-observer variability and questionable repeatability in tests which are currently utilized; furthermore, these tests can only quantify spherical or meridional aniseikonia at limited locations in the visual field. The goal of our experiment was two-fold: first, to quantify the magnitude of aniseikonia at multiple locations and second, to assess the precision and repeatability of these measurements. We used a dichoptic localization task in which 23 observers performed radial alignments at 24 locations in the visual field on two separate occasions. Observers compared the perceived eccentricity of a reference stimulus (left eye) to that of a test stimulus (right eye) while centrally fixating. The relative eccentricity between the test and reference stimuli at perceptual alignment was used to compute the degree of aniseikonia at each location. We then used Zernike polynomials as basis functions to describe the global pattern of aniseikonia. Location-specific confidence intervals and Bland-Altman analyses were used to quantify precision and inter-session repeatability, respectively. The group mean precision was 1.18° and was dependent on visual field location. The smallest detectable change for each of the coefficients ranged from 9% (Z3) to 25% (Z2) aniseikonia. The inter-session change in CI width was related to the inter-session change in Z1, suggesting that an observer’s precision and accuracy changed in tandem. We developed a novel paradigm to address several shortcomings of tests which are currently utilized. We believe the large intra-observer and inter-session variability may be explainable by continuous fluctuations and undercorrection of fixation disparity, which, if addressed with a gaze-contingent display, may render this paradigm highly repeatable and useful for clinical implementation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 408

Short-term monocular deprivation delays the processing of the previously-patched eye

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Alexandre Reynaud[1] (alexandre.reynaud@mail.mcgill.ca), Sasha Novozhilova[1], Robert Hess[1]; [1]McGill University

Short term monocular deprivation modulates ocular dominance, such that the previously deprived eye's contribution to the binocular percept increases, supposedly as a result of changes in contrast-gain. Therefore, as a result of an increase in contrast-gain, the processing time of the previously patched eye would be expected to speed up. The aim of this study is to test this hypothesis by examining the effects of short-term monocular deprivation on interocular synchronicity. In order to measure the interocular delay, we used a paradigm based on the Pulfrich phenomenon where a cylinder rotating in depth, defined by moving Gabor patches, is presented at different interocular phases generating strong to ambiguous depth percepts. Hence, the point of subjective equality at which the cylinder is seen rotating ambiguously (i.e. is appearing flat) characterizes the interocular delay. The interocular delay was measured at baseline before patching and at outcome, after one hour of monocular deprivation. Eight conditions were tested, defined by the patched eye (left or right), the spatio-temporal properties of the stimulus (small and slow or large and fast) and the type of patch worn during the patching period (translucent or opaque). Contrary to expectations, short-term monocular deprivation induces an interocular delay in the previously patched eye. The amplitude of this effect is larger following opaque patching compared to translucent patching. Our results demonstrate a negative effect – i.e. a slowing down in the processing time of the previously patched-eye – induced by short term monocular deprivation. This suggests that the plasticity effects of monocular deprivation are not exclusively mediated by contrast-gain mechanisms and that light adaptation mechanisms might also be involved in the plasticity resulting in processing delays as a result of short-term monocular deprivation.

Acknowledgements: This research was funded by a grant from the Canadian Institutes of Health Research (CIHR #228103) to RFH.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 586

The neural basis of the stereocontrast paradox

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Laura Palmieri[1,2], Jenny C.A. Read[1], Bruce G. Cumming[2]; [1]Bioscience Institute, Newcastle University, Newcastle upon Tyne, UK, [2]Laboratory of Sensorimotor Research, National Eye Institute, National Institutes of Health, USA

When human observers view 1D gratings at low contrast in both eyes, increasing the contrast in one eye decreases stereoacuity. This puzzling stereocontrast paradox does not occur in 2D stimuli like random-dot patterns, and little is known about its neural basis. Here, we report the effect of interocular contrast differences on disparity-selective neurons recorded extracellularly from V1 of awake fixating macaques. We presented 2D (random-dot, RDS) and 1D (line, RLS) stereograms under four contrast conditions: high (HH) and low contrast (LL) for both eyes, high contrast for one eye and low contrast for the other (HL) and its reverse (LH). We compared disparity modulation in the latter conditions to that in HH. Modeling predicts that these should be linearly related, with the slope equal to the product of the monocular contrasts and any contrast gain terms. When contrast was low in both eyes, slopes were lower for RDS than for RLS [LL: mean slope = 0.14 for RDS, 0.67 for RLS, t-test $p < 0.001$]. This suggests stronger contrast gain control for RLS. For RDS, slopes were systematically higher –and thus disparity tuning stronger– when contrast was low in only one eye than when it was low in both, as expected without gain control [RDS: 0.14 for LL, 0.39 for average (LH,HL), $p < 0.01$]. However for RLS, slopes were similar whether contrast was low in one eye or both [RLS: 0.67 for LL, 0.60 for (LH,HL), $p > 0.05$]. The stereocontrast paradox seen in gratings may partly reflect the V1 gain control seen in RLS, which tends to keep disparity modulation amplitude similar whether contrast is low in one eye or both. In RDS, weaker gain control in V1 produced stronger disparity modulation when contrast is low in only one eye. This may explain why the stereocontrast paradox is not reported in RDS.

Acknowledgements: WellcomeTrust/NIH 4years-PhD Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

I am available on Zoom for meeting and discussions on June 19th (15:00EST) and June 22nd (18:00 EST)!

Please contact me at L.Palmieri2@newcastle.ac.uk or palmieril2@nih.gov if you would like to schedule an additional meeting or if you have specific questions regarding my poster.

Abstract ID: 708

V1 laminar spiking responses to binocular stimuli of varying contrast

Poster Presentation - *Topic area: Binocular Vision: Models and mechanisms*

Blake A. Mitchell[1] (blake.a.mitchell@vanderbilt.edu), Kacie Dougherty[2], Jacob A. Westerberg[1], Brock M. Carlson[1], Loic Daumail[1], Alexander Maier[1], Michele A. Cox[3]; [1]Vanderbilt University, [2]Princeton University, [3]University of Rochester

Our forward-facing eyes provide two streams of visual information that merge into a single, coherent view. Psychophysical and anatomical studies have pointed to neurons in the primate primary visual cortex (V1) as playing an important role for this binocular combination. Yet, it remains unclear how V1 orchestrates the integration of two separate thalamocortical inputs into a combined binocular response. Previous neurophysiological and fMRI studies using binocular stimuli of similar and different contrast levels suggest that binocular combination in V1 is best explained by models incorporating sublinear summation of monocular inputs. However, we know little regarding the laminar specificity of these models. To address this question, macaque monkeys were trained to fixate while viewing static sinusoidal gratings of varying image contrast that were either presented monocularly or binocularly through a calibrated mirror stereoscope. Using linear multielectrode arrays, we recorded population spiking activity across the laminae of V1. Multiple electrophysical criteria were then used to group electrode contacts into three functionally-relevant groups corresponding to each the granular (middle), upper, and deep V1 laminae. We found binocular stimuli generally evoked stronger neural activity than their monocular counterparts for all contrast levels. A comparison between predicted and observed binocular responses revealed that linear summation failed to accurately account for binocular responses across V1 laminae (mean difference between predicted and observed = 12.2 ± 6.1). In contrast, the psychophysics-derived quadratic summation model that employs sublinear additivity of the two eyes' inputs fit the observed data well overall (mean difference = -0.9 ± 3.5). The best fit was found in the deep layers (M = -0.1 ± 1.3) and the worst in the upper layers (M = -1.9 ± 5.1). These results correspond to similar observations of human fMRI and extend these findings to the level of population spiking responses across the laminar microcircuit of V1.

Acknowledgements: NIH-NEI grant: 1R01EY027402-03

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 1:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Hi everyone, thank you so much for your interest in my poster presentation! I have scheduled two zoom meeting times for us to meet: (1) 12:00-12:40am CST and (2) 5:00-5:40pm (see dates above).

Abstract ID: 860

Binocular Vision: Rivalry, bistability

A re-examination of dichoptic tone mapping methods

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Minqi Wang[1] (mwang67@berkeley.edu), Emily A. Cooper[1]; [1]University of California, Berkeley, Berkeley, CA USA

Digital reproductions often aim to recreate the visual experience of viewing a physical scene. Current reproduction pipelines are limited by the luminance dynamic range of typical cameras and displays, which is much narrower than the dynamic range of many physical scenes. Thus, reproducing visual contrast and detail in a way that replicates the experience of a scene is a challenge, which requires mapping high dynamic range content to lower dynamic range via tone mapping algorithms. However, because tone mapping is a lossy process, it can compromise visibility and perceptual realism. It has recently been suggested that binocular vision can be leveraged to improve perceived luminance contrast by showing differently tone mapped images to the two eyes (dichoptic tone mapping). Several such tone mapping methods have been proposed but the results for improving perceptual quality are mixed. We hypothesized that these mixed results were related to the different baseline tone mapping algorithms used in perceptual comparisons. To address this issue, we conducted perceptual studies using image quality ratings and a two-alternative forced choice task to ask whether dichoptically tone mapped images were systematically preferred over a range of alternative tone mapping methods that presented identical images to both eyes. We also examined the perceived three-dimensionality of dichoptically tone mapped images for potential applications in stereoscopic 3D content. Our data suggest that preferences for dichoptically tone mapped images may be driven by a preference for one image out of the dichoptic pair, rather than a preference for the dichoptic pair together. Consistent with prior work, we found that dichoptically tone mapped images

were perceived as appearing more three-dimensional. In conclusion, when the goal of digital reproduction is to convey realistic contrast, dichoptic tone mapping may not consistently improve over conventional tone mapping, but it may be used to enhance the 3D impression.

Acknowledgements: This work was supported by a research gift from Facebook Reality Labs and an NEI Vision Science Training Grant (T32EY007043).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 887

Central vision prefers context incongruent stimulus at multiple levels of visual processing

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Kyuin Kim[1] (kyuink@yonsei.ac.kr), Sang Chul Chong[1,2]; [1]Graduate Program in Cognitive Science, Yonsei University, [2]Department of Psychology, Yonsei University

Central vision is so powerful that it interferes with visual processing or reconstructs perception in peripheral vision. Nevertheless, it is possible that the peripheral vision also shapes the central vision. To test this possibility, we manipulated congruency between central stimuli and peripheral context, by presenting multiple stimuli identical to either of the two rivaling central stimuli in the periphery. Thus, a central stimulus in one eye was congruent to the peripheral context and the other in the opposite eye was incongruent. During a trial, the peripheral context changed occasionally depending on the current percept of the central rivaling stimuli. Using oriented Gabors, we first observed that the central stimulus incongruent to the peripheral context was more dominant than the congruent one, consistent with the previous studies. In addition, central perception was influenced by the change in the periphery. When the currently perceived congruent central stimulus became incongruent due to the change of the peripheral context, dominance duration became longer. The opposite trend was found when the currently perceived incongruent central stimulus became congruent. We observed the same results using shapes (circles or triangles) as well. Furthermore, the patterns of results were consistent when peripheral contexts were defined at the global level by varying the proportion of the two central stimuli being presented in the periphery. When the currently perceived central stimulus was (or became) incongruent to a large portion of

peripheral stimuli, its dominance duration became longer. Finally, when the central stimuli swapped between eyes, which is known to induce the immediate change of perception, the incongruent central stimulus after the swap was perceived longer than a congruent one, although the overall dominance durations after the swap were shorter than before the swap. In sum, our results suggest that peripheral contexts modulate central vision at multiple levels of visual processing.

Acknowledgements: This research was supported by the Brain Research Program of the National Research Foundation (NRF) funded by the Korean government (MSIT) (NRF-2017M3C7A1029658).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 981

Grouping dichoptically-produced plaids: Ruling out changes in interocular suppression as an explanation

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Emily Slezak[1] (easlezak@uchicago.edu), Steven K Shevell[1]; [1]University of Chicago

PURPOSE: Observers viewing dichoptic stimuli typically perceive alternations between each eye's stimulus. Sometimes, however, both eyes' images are perceived simultaneously. For example, observers can perceive a plaid from superimposing orthogonally oriented gratings from each eye (Liu et al. VR 1992). Further, if two sets of such gratings are presented together, one set above fixation and the other below, observers perceive both as plaid simultaneously above chance ($p<0.05$; Slezak et al. JOV 2019), suggesting a grouping mechanism acting on binocularly-integrated representations of plaid; an alternative, however, is overall inhibition of interocular suppression. Two experiments rule out [1] global inhibition of interocular suppression across the entire visual field and [2] inhibition of interocular suppression in one part of the visual field inducing inhibition in another part. METHODS: For [1], two different dichoptic images were presented (rivalrous gratings as before and, separately, rivalrous radial lines and concentric rings), matched in spatial frequency and chromaticity but not in superimposed pattern. The experiment measured when both appeared superimposed. For [2], two different dichoptic gratings known to produce different durations of plaid percepts were presented together. The experiment measured whether the incidence of plaid differed when they were presented together compared to each alone. RESULTS/CONCLUSIONS: The different fused percepts from [1] were never perceived simultaneously more often than chance, which is

not in accord with global inhibition of interocular suppression. In [2], the presence of a second set of dichoptic gratings never significantly increased the amount of time plaid was seen compared to when one set was presented alone; this is not what's predicted by inhibition of interocular suppression in one area driving another. Overall, there is no evidence to support inhibition of interocular suppression as the cause for seeing two plaids simultaneously, adding support for a grouping mechanism that acts on binocularly-integrated plaid representations.

Acknowledgements: Funding Source: NIH EY-026618

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 200

Monocularly-directed attention transiently shifts eye dominance measured by binocular rivalry

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Sandy Wong[1] (sandy.wong@mail.mcgill.ca), Alex S Baldwin[1], Kathy T Mullen[1], Robert F Hess[1]; [1]McGill University

Attention directed to one eye can increase the strength of that eye's contribution to perception. It is known that when probe stimuli appear monocularly in bistable paradigms there is a shift in dominance toward the probed eye. This occurs more quickly when subjects simultaneously perform a task where they attend to the probe stimulus. Here, we investigate transient shifts in attention after presentation of an attended probe stimulus during binocular rivalry. We measure eye dominance using continuously reported rivalry percepts. Binocular rivalry stimuli were cross-oriented gratings presented to each eye. Subjects (n=17) used a joystick to report a continuous measure of dominance during rivalry. In the probe task, subjects judged the symmetry of twelve coloured circles surrounding the rivalry stimulus. We tested an "active" condition (subjects performed the probe task) and a "passive" condition (subjects did not perform the probe task). We tested conditions where probe stimuli were presented to the left eye, right eye, and binocularly (a control). Time courses of the continuously reported percepts were aligned to each attentional cue onset and averaged across subjects. From the average time courses, we find that upon monocular presentation of the probe, dominance transiently shifts toward the probed eye during rivalry. However, this shift does not

occur when the probe is binocularly presented, nor when no probe is presented at all. This result suggests that attention can modulate eye dominance at the eye specific level.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1450

Perceptual switch creates a transient bias in favor of the new state at neighboring locations. Stimulus ambiguity does not matter.

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Alexander Pastukhov[1] (pastukhov.alexander@gmail.com), Claus-Christian Carbon[1]; [1]University of Bamberg, Germany

When several multistable objects are presented simultaneously, they tend to be in the same perceptual state, the effect called “perceptual coupling”. Here, we demonstrate that it is a change in perception that broadcasts a transient bias in favor of the new state to nearby objects. To this end, we presented two ambiguously rotating spheres asynchronously, so that the onset of the second (probe) sphere was systematically varied relative to an induced perceptual switch in the first (prime) sphere (SOA -300..+400 ms). A perceptual switch was induced by reversing the on-screen motion. At the time of the switch, the prime sphere was either fully ambiguous (bistable) or disambiguated using stereoscopic depth cues. We found that the influence of the prime on the probe was the strongest when the probe appeared approximately 50-100 ms after the on-screen motion reversal. We modeled the interaction via a hierarchical Bayesian regression by assuming that probe sensitivity to the bias and the strength of the bias, which was induced by the prime, both decay exponentially. The former decayed with a rate of approximately 1/100 ms, whereas the latter had a slower decay rate of 1/220 ms (for disambiguated prime) and 1/270 ms (for bistable prime). To summarize, a change in a perceptual state of an object elicited a short-lived bias in favor of the new perceptual state, which was broadcasted to the neighboring objects. This indicates that a perceptual switch is a non-local event that also affects spatially adjacent neural representations. Importantly, this bias was produced by both bistable and disambiguated objects. This points towards general mechanisms of visual perception, which are common to both exogenously and endogenously induced changes in perception. Finally, the switch-time transient nature of new-state bias propagation matches well-known neural correlate of perceptual switches in the frontoparietal network.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 349

Plaid from orthogonal rivalrous gratings: Binocular resolution of competing neural representations

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Xiaohua Zhuang[1,2] (zxhelsa@gmail.com), Steven K. Shevell[2,3,4]; [1]Illinois College of Optometry, [2]Institute for Mind and Biology, University of Chicago, [3]Department of Psychology, University of Chicago, [4]Ophthalmology & Visual Sciences, University of Chicago

Monocular presentation of alternating orthogonal gratings at a frequency above critical fusion gives the percept of a plaid. Recent studies of interocular-switch rivalry (ISR) show that a plaid percept occurs at a much lower temporal frequency. The question addressed here is whether the plaid perceived using ISR is caused by reduction of contrast sensitivity in the magnocellular (MC) pathway, which then reduces interocular suppression, leading to binocular superposition. Methods: In Experiment I, orthogonally oriented luminance gratings were presented to the two eyes in three conditions: (1) standard binocular rivalry (SBR) condition, in which each eye saw only one of the two gratings during an entire 10-second trial; (2) interocular-switch rivalry (ISR) condition, in which the orthogonal gratings were swapped between the two eyes every 160 msec (3.13 Hz) during a trial; or (3) binocular non-rivalrous viewing (NR) condition, in which both eyes saw the same grating at any given moment, with the grating alternating between two orthogonal orientations every 160 msec. In Experiment II, prior adaptation to 10-Hz full field luminance flicker was added before each trial to desensitize the MC pathway and thereby assess the role of MC contrast sensitivity in perceiving binocular plaid. Results and conclusions: Plaid was observed more often in the ISR condition than in other conditions. Thus, swapping the orthogonal stimuli between the two eyes facilitated the appearance of plaid. Plaid was rare in the NR condition, eliminating the possibility that plaid was caused by superposition of a monocular grating with an afterimage of the most-recently-extinguished grating. Adaptation to luminance flicker did not significantly alter the perception of plaid. These results are consistent with the hypothesis that transient swapped stimuli with ISR are sufficient to reduce interocular suppression, thereby achieving binocular superposition, assuming very rapid MC recovery from preceding flicker adaptation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 221

Spontaneous and voluntary eyeblinks differentially affect target detection during continuous flash suppression

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

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This study investigated how different types of eyeblinks, i.e., spontaneous (unintentional) and voluntary (intentional) eyeblinks, affect target detection during continuous flash suppression (CFS). CFS refers to a strong interocular suppression that can be produced by presenting a high-contrast dynamic pattern (suppressor) to one eye. In this study, we used breaking CFS paradigm in which after exclusive dominance of the suppressor had been established, luminance contrast of a target, which was presented to the other eye, was ramped up to its maximum (0.8) over 3.0 sec. The time required for target detection was measured. The suppressor was a color Mondrian pattern refreshed at 10 Hz, and the target was a Gabor patch (1.06 cpd, clockwise or counter-clockwise orientation, $\sigma = 1°$). Results showed that the detection time was longer when a spontaneous eyeblink occurred before target detection than when no blink occurred. However, time interval between an eyeblink and target detection was very variable, suggesting that spontaneous eyeblinks themselves did not affect target detection. By contrast, the detection time was shorter when a voluntary eyeblink was generated in response to a visual cue. Moreover, a close temporal relationship was found between a voluntary eyeblink and target detection; the detection time was peaked 0.5 sec after eyeblinks. Differential effects of spontaneous and voluntary eyeblinks on target detection suggested that a transient change in a retinal image caused by eyeblinks did not play a critical role in modulating target detection. Consistently, a physical blackout, which was produced by darkening the stimulus display and had timing and duration comparable to eyeblinks, did not affect target detection. Furthermore, we also found that the detection time was shorter when voluntary eyelid opening was generated. Collectively, the present findings suggested that extra-retinal processing associated with voluntary eyelid movements facilitates target detection during CFS.

Acknowledgements: Supported by JSPS KAKENHI (26285162 & 18K18686)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1642

The role of 3D rotation in perceptual bistability

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Abhilasha R. Jagtap[1], Jan W. Brascamp[1]; [1]Michigan State University

Bistability arises under prolonged observation of ambiguous figures, leading to sudden and unavoidable changes in perception even though the stimulus remains unchanged. There is a considerable inter-individual variability in the switch rates for any bistable stimulus. Moreover, recent evidence suggests that switch rates for some forms of perceptual bistability are correlated, but not for others. Such correlation patterns are noteworthy as they provide a foothold for identifying neural mechanisms that are shared among clusters of bistability phenomena. One correlated cluster is formed by Necker cube (NC), binocular rivalry (BR) and moving plaids (MP). This suggests a shared mechanism between those forms of bistability, and in previous work we hypothesized this mechanism to be related to surface representations. In the face of that hypothesis it is surprising that structure-from-motion rivalry (SFM) does not correlate with the cluster, even though it centrally involves surface representations as observers perceive the front and back surfaces of a rotating 3D object moving over one another. Here we investigate whether the presence of 3D rotation can cause a stimulus to give rise to a categorically different form of bistability, in which ambiguity in 3D motion, not in surface segmentation, drives perceptual dynamics. To this end we constructed a rotating Necker Cube (rNC), which has the spatial properties of NC and the added property of rotation. In a battery that included all relevant bistable stimuli, we replicate the published correlations among NC, BR and MP as well as the lack of correlation between this cluster and SFM. Critically, we observe a lack of correlation between that cluster and rNC. Since the only difference between NC and rNC is the added property of 3D rotation, the results support the idea that even when surface layout is ambiguous, motion processing mechanisms dictate perceptual dynamics for rotating objects.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 937

What determines individual differences in grouping during binocular rivalry?

Poster Presentation - *Topic area: Binocular Vision: Rivalry, bistability*

Yosun Yoon[1,2], Sang Wook Hong[1,3]; [1]Department of Psychology, Florida Atlantic University, [2]Graduate Neuroscience Training Program, Florida Atlantic University, [3]Center for Complex Systems and Brain Sciences, Florida Atlantic University

During binocular rivalry two images concurrently presented to two eyes can be combined as a coherent pattern as if perceptual experience follows Gestalt grouping principles. In the present study, we investigate whether grouping during binocular rivalry is mainly governed by eye-of-origin or pattern coherence (image-based influence) using pairs of stimuli that induce either monocular or interocular grouping. In the monocular grouping condition, a concentric ring pattern and a horizontal grating pattern were presented to each eye through a stereoscope. In this case, both eye-of-origin and pattern coherence work together to enhance the perception of each monocular stimulus. In the interocular grouping condition, each stimulus consisted of a concentric ring pattern and a horizontal grating pattern, left and right halves (Diaz-Caneja pattern). In this case, eye-of-origin promotes perception of monocular stimuli and pattern coherence promotes interocular grouping (perception of a whole concentric ring pattern or horizontal grating pattern). The results showed that the dominance duration of monocular stimuli was significantly longer than the dominance duration of mixed percepts in the monocular grouping condition as expected by combined effect of eye-of-origin and pattern coherence. However, in the interocular grouping condition, the dominance durations of monocular stimulus and interocularly grouped coherent pattern percepts were similar, indicating that eye-of-origin and pattern coherence similarly affect percepts during binocular rivalry. More interestingly, the analysis of individual differences in binocular rivalry dynamics in two conditions revealed a negative correlation. Specifically, the longer the duration of interocularly grouped percepts in the interocular grouping condition, the longer the monocular stimulus (less mixture percept) was seen in the monocular grouping condition. This negative correlation may indicate that individual differences in grouping during binocular rivalry is determined by pattern coherence, rather than eye-of-origin.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 948

Binocular Vision: Stereopsis

An Objective Method for Detecting Stereopsis Based on Steady-state Visual Motion Evoked Potential

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Yongcheng Wu[1] (wuzhuoyan@stu.xjtu.edu.cn), Guanghua Xu[1,2], Chengcheng Han[1], Xiaowei Zheng[1], Sicong Zhang[1], Bo Wang[1], Liang Zeng[1]; [1]School of Mechanical Engineering, Xi'an Jiaotong University, Xi'an, China, [2]State Key Laboratory for Manufacturing Systems Engineering, Xi'an Jiaotong University, Xi'an, China

Stereopsis is the highest function of binocular vision, which can provide an accurate judgment of distance and depth. It is quantified as stereoacuity, measured in seconds of arc (arcsec). Generally, traditional assessment methods of stereopsis, such as Random-dot Stereogram and Titmus stereopsis test, which mainly depend on the subjects' subjective perception, are very easily affected by some uncertain factors, such as low cognitive ability and impure motives. Hence, we proposed an objective method of detecting stereopsis based on steady-state motion visual evoked potential (SSMVEP).In this study, we designed a stereo SSMVEP paradigm with white noise, which used 3D shutter glasses to realize the stereo imaging based on two eyes parallax and eliminated monocular cues. The paradigm utilized periodic contraction and expansion motion to elicit SSMVEP and can change stereoscopic depth by adjusting the horizontal disparity of its two component images. Besides, the filter bank canonical correlation analysis (FBCCA) was used to analyze the electroencephalography (EEG) signals of the occipital lobe and extract relevant features to establish an index, which is corresponding to the objective stereopsis of human eyes. Eight healthy subjects(ages 23-25 years), with normal or corrected-to-normal vision, participated in the experiments. Each experiment was divided into eight trials according to the different stereoscopic depth of the paradigm, corresponding to the zero disparity stereoacuity from 800 to 0 seconds of arc. The experimental results show that as the stereoacuity decreases, the index value at the target stimulus frequency of SSMVEP shows a significant downward trend. Moreover, it decreases more significantly when the stereoacuity is less than 40 arcsec. The result of experiments is in accordance with the result obtained from the Random-dot Stereogram test. Our research has initially proved that the stereo paradigm based on SSMVEP can be used as a new objective and quantitative method for detecting stereopsis.

Acknowledgements: Supported by grants from the Independent Innovation Capacity Improvement Project of Xi'an Jiaotong University (PY3A071) and the National Natural Science Foundation of China (NSFC-51775415).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1680

Binocular Coordination and Interocular Balance in Amblyopia

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Agostino Gibaldi[1] (agostino.gibaldi@berkeley.edu), Avi M Aizenman[1], Dennis M Levi[1], Martin S Banks[1]; [1]UC Berkeley, School of Optometry and Vision Science

Saccades are ballistic eye movements that humans make to direct gaze to an object of interest. When landing on a new fixation point, effective binocular coordination facilitates accurate convergence of the eyes, helping to fuse a single image. Without accurate convergence, a double image may be perceived. We have shown that the visual system uses statistical regularities in the natural environment to aid eye alignment at the end of saccades (Gibaldi & Banks,2019), defining the empirical oculomotor horopter. This behavior is consistent when stereovision is functional and effective. In this study we investigated whether the same statistical regularities are exploited in stereoanomolous binocular vision in amblyopia and strabismus. Nine subjects participated, six with normal vision and stereovision, and three with amblyopia (at least two lines difference between the eyes) and impaired stereovision (stereothreshold > 200arcmin). Subjects performed saccades to LED targets arranged vertically, while their eye movements were recorded with an Eyelink II eyetracker. We measured horizontal vergence after completion of monocular and binocular saccades to assess whether vergence is consistent with the natural-disparity distribution. We additionally measured perceptual interocular balance by asking observers to indicate the apparent location of dichoptic stimuli with interocular contrast differences. The oculomotor horopter of healthy subjects presents a consistent pattern of divergence for upward saccades and of convergence for downward saccades. This matches environmental scene statistics, and this effect is larger with monocular viewing. In two amblyopic subjects this pattern is not present, and vergence shows greater variability as compared to healthy subjects, demonstrating a lack of binocular coordination. Interestingly, the third amblyopic observer showed only a slight imbalance, which was accompanied by better binocular coordination. The evaluation of binocular coordination could be used for an objective assessment of binocular visual dysfunction, useful for screening young, non-collaborative patients and possibly early intervention.

Acknowledgements: We thank Cliff Schor for helpful discussions. Funding: Research was funded by NSF Research Grant BCS-1734677, Corporate University Research, Intel Labs, and the Center for Innovation in Vision and Optics.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1623

Interocular difference in spatial frequency but not size mediates a Pulfrich phenomenon

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Seung Hyun Min[1] (seung.min@mail.mcgill.ca), Alexandre Reynaud[1], Robert F Hess[1]; [1]McGill Vision Research, Dept. Ophthalmology and Visual Sciences, McGill University

The Pulfrich effect is a stereo-motion phenomenon. When the two eyes are presented with visual targets moving in fronto-parallel motion at different luminance or contrast, a target moving-in-depth is perceived. This percept of motion-in-depth occurs because lower luminance or contrast is thought to delay visual processing. Spatial properties of an image such as spatial frequency and size have also been shown to influence the speed of visual processing. In this study, we used a paradigm, based on the Pulfrich phenomenon, where a structure-from-motion defined cylinder – composed of Gabor elements displayed at different interocular phases – rotates in depth to measure interocular delay. Hence, we measured the relative delay in processing between the eyes while independently manipulating the spatial frequency and size of the Gabor patches. Seven adults with normal vision were tested. We show that interocular differences in spatial frequency of the Gabor patches, but not size, produces processing delays.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 775

Mobile devices in vision screening: examination of stereovision

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Zsófia Csizek[1] (csizekzsofia@gmail.com), Eszter Mikó-Baráth[1], David P Piñero[2], Anna Budai[1], Kitti Szabó-Guth[1], Péter Hegyi[1], Ágota Pusztai[3], Adrienne Csutak[3], Gábor Jandó[1]; [1]Institute of Physiology, University of Pécs, Medical School, [2]Department of Optics, Pharmacology and Anatomy, University of Alicante, [3]Department of Ophthalmology, University of Pécs, Medical School

Amblyopia is a neurodevelopmental disorder with reduced visual acuity and impaired stereovision, therefore stereotests can be utilized to detect amblyopia and preamblyopic conditions. Our research group is developing a mobile device-based vision screening system (EuvisionTab©). The stereovision module of this application can display static and dynamic random dot stereograms. The goal of this study was to compare the performance of these tests with others. Four hundred fifty-three individuals (4-13 yrs) were included, 46 of them were amblyopic. A pediatric ophthalmological examination was performed before testing. In our stereotest, the dot density was varied to adjust the level of difficulty. Low density dynamic (1%) with noise (LDD), very low density dynamic (0.7%) without noise (VLDD), and a higher density (8%) static test (HDS) were used and compared with Lang II, TNO, StereoFly and Frisby stereotests. The predictive values and ROC analysis were calculated for each stereotest. With refractive correction, HDS, LDD, and VLDD had a sensitivity for amblyopia of 77%, 91%, and 87%, while the specificity was 89%, 71%, and 74%, respectively. The sensitivity and specificity of the Lang II, TNO, StereoFly and Frisby stereotests were: 63% and 96%, 88% and 82%, 85% and 88%, and 76% and 79%, respectively. Without refractive correction, which better resembles a real screening situation, the sensitivity of LDD and VLDD were 91% and 100%, respectively. The EuvisionTab© stereotests are slightly more sensitive for the detection of amblyopia compared to any other stereotests. LDD and VLDD have significantly higher sensitivity and lower specificity, while HDS has comparable or slightly better performance in both measures when compared to other stereotests. Our stereotests may become part of the state-of-the-art vision screening protocol, because of advantages such as cloud-based data storage, flexible parameter settings and randomized image sequence.

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Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 395

Perceived luminance contrast of stereoscopic patterns

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Goro Maehara[1] (goro@kanagawa-u.ac.jp), Ikuya Murakami[2]; [1]Kanagawa University, [2]The University of Tokyo

Previous studies have shown that luminance contrast under monocular viewing appears comparable to that under binocular viewing above threshold. However, little attention has been paid to perceived luminance contrast under stereoscopic viewing. Here we compared perceived luminance contrast of patterns with binocular disparity to that of zero-disparity patterns. Two vertical Gabor patterns were successively presented in each trial. The first pattern was the standard stimulus that had no binocular disparity. The second pattern was the comparison stimulus that had -1, -0.5, -0.25, 0, 0.25, 0.5, or 1° of binocular disparity. Five observers judged which pattern had the higher luminance contrast. Luminance contrast of the standard stimulus was set to -26 or -8 dB re 1 (5 % or 40 % of Michelson contrast). Luminance contrast of the comparison stimulus was varied according to a one-up one-down staircase method with a step size of 1.5 dB. Each staircase terminated after 6 reversals. The PSEs were determined by averaging the last 4 reversals of two interleaved staircases (8 reversals in total). The results showed that the mean PSEs for -8 dB standard contrast significantly decreased as the absolute value of binocular disparity increased. The mean PSEs were -9.4 and -11.0 dB at -1 and 1° of binocular disparity, respectively, whereas it was -8.5 dB at zero disparity. That is, luminance contrast of the patterns with binocular disparity was perceived approximately 1.10 and 1.34 times higher than that of a zero-disparity pattern. There was a similar significant trend for -26 dB standard contrast, although the effect was relatively small. The results will be discussed in terms of interocular suppression and stereoscopic vision.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 449

Pseudoscopic vection: Reversing stereo continues to improve self-motion perception despite increased conflict.

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Stephen Palmisano[1] (stephenp@uow.edu.au), Shinji Nakamura[2], Robert Allison[3], Bernhard Riecke[4];
[1]University of Wollongong, [2]Nihon Fukushi University, [3]York University, [4]Simon Fraser University

Research has shown that visual illusions of self-motion (vection) can be improved by adding consistent stereoscopic information to inducing displays. However here we examined the effect of placing this stereoscopic information into direct conflict with monocular motion signals (by swapping left and right eye views to reverse disparity). We compared the vection in depth induced by stereo-consistent, stereo-reversed and flat-stereo displays. We also manipulated the amount of monocular self-motion information in these inducing displays (by providing explicit changing-size cues in half of the trials). As expected, we found that stereo-consistent conditions improved the vection induced by both changing-size and same-size patterns of optic flow (relative to their equivalent flat-stereo conditions). However, stereo-reversed conditions were also found to improve the vection induced by same-size patterns of optic flow. Additional evidence from our experiments suggested that all of these stereoscopic advantages for vection were due to the effects on perceived motion-in-depth (not perceived scene depth). These findings demonstrate that stereoscopic information does not need to be consistent with monocular motion signals in order to improve vection in depth. Rather they suggest that stereoscopic information only needs to be dynamic (as opposed to static) in order to enhance the experiences of vection induced by optic flow.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please send me an email (stephenp@uow.edu.au), if you would like to discuss any aspects of this research (or my other work on the effects of pseudoscopic viewing):

Palmisano, S., Nakamura, S., Allison, R.S., & Riecke, B.E. (2020). The stereoscopic advantage for vection persists despite reversed disparity. Attention, Perception & Psychophysics, 82, 2098-2118. https://doi.org/10.3758/s13414-019-01886-2

Palmisano, S., Hill, H., & Allison, R.S. (2016). The nature and timing of tele-pseudoscopic experiences. i-Perception, 7(1), 1-24. https://doi.org/10.1177/2041669515625793

Abstract ID: 339

Reliable depth perception in the absence of awareness for peripherally viewed anticorrelated stereograms

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Jordi Asher[1] (jashera@essex.ac.uk), Paul Hibbard[1]; [1]University of Essex

Anticorrelated random-dot stereograms (aRDS) are stimuli comprised of a binocular pair of images of randomly positioned dots in which the dots in one eye's view are replaced by their photographic negatives. In some cases, the binocular energy model of neural responses predicts that the perception of depth should be reversed for aRDS. In contrast, the responses from second-order channels predict the perception of depth in the forward direction (Asher & Hibbard, 2008). Findings of reversed-depth perception are inconsistent, and highly dependent on the type of stimulus, its location and the duration of presentation. Zhaoping & Ackermann (2018) showed that the perception of reversed depth is more robust in the periphery compared to centrally presented targets, and argued that this reflects a reduction in top-down feedback in the periphery. We assessed the effects of stimulus eccentricity (0 to 15.5 degrees) and duration (80 or 700ms) on the perception of depth from correlated and anticorrelated RDS. Stimuli were either circular targets a horizontal depth edge. Observers indicated whether the target appeared near or far, and also whether they were confident in this judgement. For correlated stimuli, depth judgments were accurate at all eccentricities, but confidence fell for peripheral stimuli. For anticorrelated stimuli at the short presentation time, no depth was seen for the circular stimuli, and forward depth was seen for the horizontal edge stimuli. For long presentations, reversed depth was seen for circular stimuli, and forward depth for edge stimuli, at all eccentricities. Confidence fell to zero for stimuli presented at an eccentricity of 15.5 or beyond. Reverse depth in aRDS is possible with extended presentation times, but only for the circle condition for which second-order responses are unreliable. For peripherally presented random dot stereograms, reliable depth judgments were found in the absence of awareness of depth.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1745

Scaling stereoscopic depth: The role of reaching

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Brittney Hartle[1] (brit1317@yorku.ca), Laurie Wilcox[1]; [1]York University

Biases in suprathreshold depth estimation from stereopsis have been reported over a wide variety of viewing distances, stimulus geometry, and estimation methods - particularly for virtual stimuli. These depth distortions are often attributed to incorrect scaling of binocular disparity via absolute distance. This assumption supported by the fact that physical stimuli tend to produce more accurate depth scaling, but systematic errors often persist. However, we do not just look at the world around us; we interact with objects and potentially obtain proprioceptive cues to distance. There is strong evidence that stereopsis aids actions such as reaching and grasping (Loftus et al., 2004); is the reverse also true? Here we assessed the impact of proprioceptive distance information from arm's reach on depth estimation. We compared depth magnitude estimates before and after observers performed reaching movements in a virtual environment. Observers estimated the relative depth between a rectangle and reference frame using a pressure-sensitive strip before and after performing a reaching task. When reaching, observers used hand-held controlllers with their index finger extended. The finger tip was tracked and represented by a dot while they touched a virtual square within a reference frame presented at 50cm for a total of 60 trials. In a control experiment, observers performed this same task without reaching, using head movements alone. We found that depth estimation accuracy improved after observers engaged with the target in the reaching task. However, without reaching movements observers showed no such improvement. Further, there was no change in the precision of depth estimates after either type of task (reach or no-reach). The observed improvement in depth estimation reflects a cross-modal calibration of visual space that may be important for everyday interactions. Further, it is likely that this relationship could be exploited in immersive environments to improve accuracy of visuomotor performance.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 533

Seeing double: The impact of perceptual organization on the limits of binocular fusion

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Arleen Aksay[1] (arleen4@my.yorku.ca), Laurie M. Wilcox[1]; [1]Centre for Vision Research, York University

For a given disparity between two points, there is a 2D separation at which the fixated and disparate points cannot be fused simultaneously. The ratio of that disparity to the angular separation is referred to as the disparity gradient limit (Burt & Julesz, 1980). The disparity gradient limit is believed to reflect geometric constraints on fusion. However, this assumption is called into question by the observation that under natural viewing conditions violations of the disparity gradient limit are common, but diplopia is rarely

experienced. One explanation for this discrepancy is the fact that laboratory studies of fusion limits typically use simple isolated stimuli, while objects in the real world are more complex, with multiple connected components. We hypothesized that perceptual organization (via connectedness) modulates the perception of diplopia and used the method of adjustment to assess the impact of connectedness on fusion limits. Pairs of dots were presented stereoscopically at a fixed vertical separation either in isolation or connected by horizontal lines, at a range of disparities. Gaps were added in the lines to manipulate connectedness. Vergence demand was controlled by presenting the upper and lower dot pairs in both uncrossed and crossed directions, and by limiting stimulus duration to 100ms. Our results consistently show that increasing element connectedness significantly increases the disparity gradient limit; the fusion limit occurred at larger disparities when elements were connected by a continuous line, and intermediate when they were connected by discontinuous lines. These data suggest that the disparity gradient limit does not reflect a low-level constraint on fusion but is modulated by perceptual organization. From this work it appears that in addition to supporting figure/ground segmentation, perceptual grouping plays an important role in mitigating diplopia.

Acknowledgements: Natural Sciences & Engineering Research Council of Canada

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1154

The effect of head- and stimulus tilt on stereoacuity

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Jan Skerswetat[1] (j.skerswetat@northeastern.edu), Andrea Caoli[1,2], Peter Bex[1]; [1]Northeastern University, USA, [2]Università degli Studi di Genova, Italy

Stereopsis is traditionally measured by using stereo tests that are presented upright while the observer views the test in a habitual head position. Here, we investigated the effect of head-and stimulus tilt on stereoacuity. First, we measured stereoacuity using a 4AFC bandpass-filtered circles(size=1.25°; sf=4cyl/°) on a passive-3-D-monitor with enforced eye-and head positions. Head tilts were 0° or ±20° pitch, roll, or yaw. Ten binocularly normal(Titmus 60’’ or better) adults fixated a central cross and clicked on the circle with a backwards depth for forty trials/condition. Stereoacuity thresholds(62.5% cumulative-Gaussian-fit) worsened with tilt, but did not significantly differ from the 0° condition[p>0.05]. Next, we measured

stereoacuity while either the head(H), monitor(M), or both(B) were tilted 0°, ±22.5°, or ±45° roll in random order (eighty trials/condition). The stimulus size was 8°, made of four quadrants, each containing 0.04° Gaussian dots(30dots/°-2). Interocular disparity was Gaussian(σ=0.67°), convex in three and concave in one quadrant. The task for eight participants was to click on the concave target. There was a significant interaction between conditions and tilts[$p<0.05$], which was due to decreasing stereoacuities with increasing tilt for conditions H and M[$p<0.05$], but not B[$p>0.05$]. Stereoacuities for M tended to be worse than for H, but this trend was not significant[p = 0.084]. The decrease in stereoacuity with tilt was greater for left- compared to right-roll(M=1.3 vs. 1.1"/°[p=0.001]; H=1.1 vs. 0.8"/°[p=0.01]; B=0.09 vs. 0.05"/°[p=0.23], respectively). Stereoacuities were unaffected by head tilt using sparse-circles, but significantly changed using dot stimuli, indicating a role for stimulus density in depth perception assessment. Cyclotorsions have a negligible effect on stereoacuity since there was no effect of tilt in B nor a significant difference between H and M. Rolling the head leftwards generates poorer stereoacuities than rightwards. The results may have implications for clinical screening in patients with abnormal head posture.

Acknowledgements: This research was funded by the National Institutes of Health (R01 EY029713 awarded to author P.J.B.). The authors declare no conflict of interests.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

If you would like to chat outside of the scheduled times, drop me an email so that we can arrange other times: j.skerswetat@northeastern.edu

Abstract ID: 1570

Transfer and Retention of Oculomotor Alignment Rehabilitation Training

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Kerri Walter[1] (walter.ker@husky.neu.edu), Yesenia Taveras Cruz[2], Peter Bex[3]; [1]Northeastern University

Ocular alignment defects, including strabismus and convergence insufficiency, affect around 5% of people and are associated with binocular vision impairments. Current treatments lack quantitative endpoints and have high levels of recidivism. We develop a rehabilitation method for ocular alignment training and examined the rate of learning, transfer to untrained alignments, and retention over time. Ocular alignment was controlled with a real-time dichoptic feedback paradigm in which a fixation target was presented only

to the fixating eye and a gaze-contingent ring was presented only to the alignment eye. Observers were required to move their eyes to center the ring on the target, with feedback provided by the size and color of the ring. By offsetting the ring temporally or nasally, this task required convergent or divergent deviation, respectively, of the alignment eye. Learning was quantified as the time taken to attain target deviation of 2° or 4° for convergence (C2, C4) or divergence (D2, D4) over 40 trials. 32 normally-sighted observers completed 2 training sessions separated by 1 week. Each session, subjects completed 3 alignment tasks and were randomly assigned to a test sequence: C2-C4-D2, C4-C2-D2, D2-D4-C2, or D4-D2-C2. The time taken to achieve alignment was higher for greater deviation angles ($p<.001$) but there was no significant difference between divergent and convergent directions ($p=.910$). Previous training on one deviation angle transferred to untrained angles within convergence or divergence ($p<.001$) but not between these directions ($p=.365$), and times were significantly shorter in the second session ($p<.001$). The results show that oculomotor alignment can be rapidly trained with a feedback based dichoptic paradigm. Training is transferred and retained over at least one week within the same deviation direction, but not between deviation directions. Feedback-based oculomotor training may therefore provide a non-invasive method for the rehabilitation of ocular alignment defects.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1314

Why is stereoacuity poor in amblyopia? Evidence from a disparity noise-masking paradigm

Poster Presentation - *Topic area: Binocular Vision: Stereopsis*

Sara Alarcon Carrillo[1] (sara.alarconcarrillo@mail.mcgill.ca), Alex S. Baldwin[1], Mao Yu[2], Jiawei Zhou[2], Robert F. Hess[1]; [1]McGill University, [2]Wenzhou Medical University, Wenzhou China

People with amblyopia generally have a reduced ability to use stereopsis to make depth judgements. Our understanding of this reduced ability is limited by the insensitivity of standard clinical stereo tests. These tests fail to detect residual stereo function in some amblyopic subjects. The current study employs a test designed for individuals with poor stereoacuity. The subject identifies the location of a 3D target in a random-dot display. The target is presented in stereoscopic depth using 3D shutter-glasses. We applied the equivalent noise method to determine the role of equivalent internal noise (signal to noise ratio of disparity signals) and processing efficiency (how efficiently the system processes noisy input) in amblyopic

stereopsis. We tested 30 amblyopic (7 strabismic, amblyopic eye visual acuity above 20/200) and 17 control (visual acuity above 20/20) adults. Our test detected stereoacuity in 50% of amblyopic participants. Amblyopic stereoacuity thresholds (m =118 arsec) were significantly higher than those from controls (m = 57 arcsec) ($t = 2.8$, $p < 0.05$). From a linear amplifier model fit, we found higher mean equivalent internal noise in amblyopic subjects (239 arsec) compared to controls (134 arcsec) ($t = 3.45$, $p < 0.05$). The two groups did not significantly differ in the processing efficiency for the task. A multiple linear regression was performed to determine the contribution of the two factors (equivalent internal noise and efficiency) to the individual differences in amblyopic stereoacuity. The two factors accounted for 66% of the variance in stereoacuity, with differences in equivalent internal noise as the strongest predictor. This study introduced a more sensitive assessment of residual stereopsis in amblyopia and evaluated how two factors contribute to individual performance. Overall, we find that reduced amblyopic stereoability is explained by poorer input quality to the stereoscopic disparity processing mechanism.

Acknowledgements: Funding from the Natural Sciences and Engineering Research Council of Canada (NSERC grant to R. F. H. #2016-03740), Fonds de Recherche Santé Québec (FRQS grant to S.A.C), Vision Health Research Network (to S.A.C), McGill University Health Centre (to S.A.C) and McGill Ophthalmology (to S.A.C).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1634

Color, LIght and Materials: Cognition

Acquisition of colour categories through perceptual learning: differences between hue and lightness

Poster Presentation - *Topic area: Color, LIght and Materials: Cognition*

Jasna martinovic[1] (j.martinovic@abdn.ac.uk); [1]University of Aberdeen

Ozgen and Davies (2002, JEP:G, 131, 477-493) provided evidence in favour of learned categorical perception of colour, both in terms of hue and lightness-defined categories. To throw further light on potential differences between hue and lightness-based category learning, their findings were reassessed in

an experiment that closely followed their methodology, with hue and lightness learners training on a novel category boundary within the green region of colour space. After training, hue and lightness learners as well as untrained controls (15 participants per group; 45 in total) performed delayed same-different discrimination for both lightness and hue pairs. Ozgen and Davies used stimuli from the Munsell space. Here, stimuli were selected from CIE Lab space - equated in terms of chroma, spanning roughly the same area of lightness and a somewhat wider set of hues in the lime-green/green area of colour space than in Ozgen and Davies (147°-171° as opposed to 159°-173°, maintaining the same distance ΔE=6). In addition to discrimination data, we monitored errors made during learning and asked participants to report on any colour-labelling strategies. Main findings are as follows: 1) For lightness learners, mistakes during training accumulated evenly around the newly learned category boundary, but for hue learners they were distributed non-uniformly, in accordance with the Bezold-Brucke effect; 2) almost all learners reported using labelling strategies during both training and discrimination, with hue learners mainly using green/blue and lightness learners mainly using light/dark. The “blue” label was associated with the greener colours (i.e., the ones closer to unique green). The results indicate that existing colour labels can play a role in perceptual learning and that this labelling does not have to conform to everyday naming (i.e., blue is used for stimuli that would otherwise be named as green).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

If you're having issues accessing the pdf due to server overload, please email me at j.martinovic@abdn.ac.uk and I will send you a copy.

Abstract ID: 497

Are light and dark blue used as separate basic color categories in English?: A corpus linguistics approach to studying visual perception

Poster Presentation - *Topic area: Color, LIght and Materials: Cognition*

Anke Marit Albers[1] (anke-marit.albers@psychol.uni-giessen.de), Sean Isamu Johnson[2], David H. Peterzell[3.4]; [1]Justus Liebig University, Giessen, Germany, [2]Hofstra University, Hempstead, New York, USA, [3]John F. Kennedy University, Pleasant Hill, California, USA, [4]University of California, Berkeley, California, USA

Although people perceive countless different colors, they typically use 11 discrete ‘basic’ or ‘universal’ terms to categorize hues. However, multiple languages (e.g. Russian, Greek, Italian, Lithuanian; Bimler & Uusküla, 2014, 2017; Paramei, 2005, 2007) use different terms for different blues, suggesting additional basic-level distinctions (e.g., Italian: blu, azzurro, celeste). Experiments show no such distinction for blue in English (Uusküla & Bimler, 2016), but perhaps speakers use the words ‘light’ and ‘dark’ (and other specifiers) with ‘blue’ far more frequently than with other basic colors, thus identifying multiple blues in practice. To examine the use of ‘light’ blue, ‘dark’ blue, and other chromatic specifiers in daily common language, we used corpus linguistics. From the Corpus of American English (COCA, a balanced corpus with >550 million words from newspapers, magazines, academic texts, literature, spoken language) we extracted all occurrences of 11 basic color terms, and their 100 most common preceding words (collocates). We calculated the relative frequency of ‘light’ and ‘dark’ and marked all other potential specifiers of the colors. ‘Light’ and ‘dark’ indeed appeared frequently with blue (1.19, 2.15% of selected cases). There could be cases where ‘light blue’ referred to something both lightweight and blue, but subsets of unambiguous cases showed similar patterns. ‘Light’ also specified brown (2.18%), whereas ‘dark’ collocated with brown (2.60%), gray (1.71%), green (1.87%) and purple (2.05%), with much lower percentages for other colors (~0-0.82%). Finally, blue was preceded by many more unique chromatic specifiers than other colors. Results suggest: (1) American English speakers distinguish between different blue categories, resembling explicit distinctions of blues in some other languages (the pattern was even stronger for brown); (2) the separation between basic and non-basic color categories might be gradual rather than distinct in English. Issues related to developing corpus linguistics to investigate human perception and categorization are discussed.

Acknowledgements: This work was supported by the Deutsche Forschungsgemeinschaft under grant SFB/TRR 135: Kardinale Mechanismen der Wahrnehmung: Prädiktion, Bewertung, Kategorisierung (AMA)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 657

Categorical Perception of Color in Tracking Depends on Language

Poster Presentation - *Topic area: Color, LIght and Materials: Cognition*

Mengdan sun[1] (mengdansun@zju.edu.cn), Xiaoqing Gao[1], Xuemin Zhang[2]; [1]Center for Psychological Sciences, Zhejiang University, [2]Faculty of Psychology, Beijing Normal University

Is our perception of the world shaped by the language we speak? This subject has provoked controversy over the past decades. Categorical perception (CP) of color suggests that cross-category colors are discriminated better than within-category colors, initially serving as the supporting evidence for the penetrability of language on perception. However, recent findings seem to suggest language-independent CP effects. Following our previous study that revealed CP effects in a tracking task, the current study investigated the effects are dependent on language or not. We conducted two experiments where two types of verbal interference task were implemented and assessed whether the CP effects in tracking would be disrupted. In Experiment 1, the verbal interference task was an eight-digit memorization task, while Experiment 2 replaced the digits by color words. It showed that the CP effects were not influenced by the digit memorization task (Exp.1) but reduced by the memorization of color words (Exp.2). Our results suggested that the CP effects in tracking derive from the use of color labels, supporting the role of language in dynamic visual organization. Furthermore, the ability of different verbal interference tasks differs in blocking the access to color labels.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 511

Rainbow Stripes: Categorical Perception of Color

Poster Presentation - *Topic area: Color, LIght and Materials: Cognition*

Richard Krynen[1] (chandlerkrynen@gmail.com), Michael McBeath[1]; [1]ASU

Introduction: When a viewer sees a rainbow, a common experience is to perceive stripes of color despite the stimulus being a smooth gradient of pure wavelength electromagnetic frequencies. We investigated the number of stripes that were drawn by both normal vision and color blind individuals. Method: 33 normal vision and 12 color blind participants viewed a geometrically controlled 6-inch long gradient of pure wavelength colors created by refracted sunlight through a prism onto a white piece of paper. Participants were instructed to mark boundaries where each distinct color ended and another began. Results: We found the typical number of stripes indicated by normal vision participants is 6 ($\mu = 6.4$, $\sigma = 0.3$), and by color blind participants is 4 6 ($\mu = 4.7$, $\sigma = 1.2$). These numbers are significantly less than the 7 prototypical ROYGBIV categories of color traditionally specified by Newton and others. We also found that the longer wavelength colors of red and purple are more salient with wider perceived stripes. Discussion: The effect of seeing a limited number or color stripes confirms color as a prototypical example of categorical perception that is consistent with our limited number of types of color receptor neurons. Given that the

electromagnetic frequencies of light wavelengths in a rainbow change as a smooth continuum, the perception of color stripes could be framed as a categorical illusion. It may also reflect functional divisions used to separate meaningful real-world distinctions, possibly such as bluish liquids, greenish plants, and reddish earth tones.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1792

Color, Light and Materials

Bayesian Image Reconstruction from Retinal Cone Signals

Talk Presentation - *Topic area: Color, Light and Materials*

Ling-Qi Zhang[1] (zlqzcc@gmail.com), Nicolas P. Cottaris[1], David H. Brainard[1]; [1]Department of Psychology, University of Pennsylvania

The visual system takes sensory measurements of the light incident at the eyes and uses these to make perceptual inferences about external world. The sensory measurements do not preserve all of the information available in the light signal. One approach to understanding the implications of the first stages of visual processing is ideal observer analysis, which evaluates the information available to support psychophysical discriminations at various stages of the early visual representation. We are interested in extending this type of analysis to take into account the statistical structure of natural images. To do so, we developed a Bayesian method for reconstructing image stimuli from the signals available in the retinal cone mosaic. We evaluated the likelihood function using the open-source software package ISETBio (isetbio.org). ISETBio simulates the wavelength-dependent optical blur of the human eye as well as the interleaved sampling of the retinal image by the L, M and S cones. Noise in the cone signals is characterized by a Poisson process. To model the statistical structure of natural images, we applied independent components analysis to an image dataset, and fit an exponential prior to the individual component weights. We obtain reconstructions of the image stimulus using maximum a posteriori probability (MAP) estimates. Our method enables us to visualize and quantify the information loss due to optics and cone mosaic, while taking the spatial and spectral correlations of natural image statistics into account. To illustrate, we reconstructed images using a series of retinal mosaics with decreasing proportion of M cones. We quantified reconstructed image quality using the S-CIELAB difference between original and reconstructed

images. We found that the reduction of M cones has little impact until the proportion of M cones drops below 5%, at which point the reconstruction error increases dramatically as the modeled visual system eventually becomes dichromatic.

Acknowledgements: Funding: Facebook Reality Labs

This talk will be presented in [Live Talk Session 3](), Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Thanks for checking out our work! Feel free to send me an email for any related questions you may have. If you are having trouble viewing, we've also uploaded the video to YouTube: https://youtu.be/d5qI0FNCAv4

Github Page for ISETBio:
https://github.com/isetbio/isetbio

Github Page for Reconstruction:
https://github.com/isetbio/ISETImagePipeline

Abstract ID: 842

Enhancement of luminance sensitivity by chromatic pedestals - a model of nonlinear parvocellular luminance processing

Talk Presentation - *Topic area: Color, Light and Materials*

Christopher Shooner[1] (christopher.shooner@mail.mcgill.ca), Kathy T. Mullen[1]; [1]McGill University

Perceptual interactions between red-green (RG) color and luminance contrast offer insight into how these attributes are jointly encoded by parvocellular neurons of the LGN and their cortical targets. Here we show that the enhancement of luminance sensitivity by RG chromatic pedestals can be accounted for by a model in which luminance is computed cortically from the rectified outputs of parvocellular-like units. We used uniform luminance patch stimuli (4 deg diameter, 300 ms duration) presented foveally, superimposed on RG, luminance and a range of combined color-luminance pedestals of varying intensities. In a 2-interval task, subjects (n=3) identified which stimulus had the luminance increment. We also tested RG pedestals

peripherally (8 deg horizontally) using an equivalent spatial 2AFC task. Every pedestal tested reduced luminance thresholds at some intensity. The form of facilitation varied with pedestal chromaticity, with chromatic pedestals having an effect at lower pedestal contrasts. Our model predicts this chromatic tuning from the cone-opponency of parvocellular-like units. The outputs of L- and M-cone center units are rectified then summed in a luminance mechanism with an expansive output nonlinearity. Rectification prevents cancellation of L-M opponent signals, allowing RG pedestals to interact with luminance signals at the later nonlinear stage. Notably, the effects pedestals had on luminance sensitivity were not predictable from their visibility. Foveally, chromatic pedestals were visible at contrasts much lower than those that influenced luminance, unlike luminance pedestals, which had an effect near their detection threshold. In the periphery, RG pedestal detection thresholds increased by a factor of 4 or more, but the site of facilitation changed less, such that RG pedestals had an effect near their detection threshold. This dissociation suggests that the mechanisms mediating pedestal facilitation, though chromatically tuned, are distinct from those limiting chromatic detection.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

An article describing this work was just published in Journal of Vision: http://jov.arvojournals.org/article.aspx?articleid=2770153.

The Supplement is a PDF with the talk slides, not additional scientific material.

Abstract ID: 856

Psychophysical discrimination of structured light exhibiting spatially-dependent polarization

Talk Presentation - *Topic area: Color, Light and Materials*

Andrew E. Silva[1] (a8silva@uwaterloo.ca), Dusan Sarenac[1], Connor kapahi[1], David G. Cory[1], Ivar Taminiau[1], Dmitry A. Pushin[1], Ben Thompson[1]; [1]University of Waterloo

Haidinger's brush is an entoptic image of a central oblong smudge elicited when the macular pigment preferentially absorbs specific direction of polarized light. Because Haidinger's brush is dependent on macular pigment, it may have value as a screening tool for macular dysfunction. We examined whether healthy human observers could use Haidinger's brush to psychophysically discriminate between two beams of structured light exhibiting different patterns of spatially-dependent polarization, called spin-coupled Orbital Angular Momentum (OAM) states. Because the direction of polarization changes across the beam,

OAM discrimination requires the perception of a spatially-dependent pattern of multiple Haidinger's brush orientations. This richer stimulus may provide more precise information about macular function than a traditional linearly polarized stimulus. We examined the discriminability of OAM states by monocularly presenting OAM light to the eyes of 12 healthy participants. On each trial, one of two possible OAM states was presented. Participants made self-directed saccades to observe the Haidinger's brush pattern and verbally indicated the perceived state. Overall, participants successfully performed the discrimination task (68% accuracy, SD = 22%, p = 0.013). This study provides foundational confirmation that humans can discriminate quantized modes of structured light with varying degrees of success. Structured light may therefore serve as a sensitive psychophysical probe of individual differences in macula structure and function in normal and clinical populations.

Acknowledgements: This work was supported by the Canadian Excellence Research Chairs (CERC) program, NSERC grants RGPIN-2018-04989, RPIN-05394, RGPAS-477166, the Collaborative Research and Training Experience (CREATE) program, and the Canada First Research Excellence Fund (CFREF).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Some of the data shared in this talk is now published in PNAS. For more details, the link is:

https://doi.org/10.1073/pnas.1920226117

Abstract ID: 265

Robust behavioral and neural integration of color and gloss cues for object classification

Talk Presentation - *Topic area: Color, Light and Materials*

Maria Olkkonen[1,2] (maria.olkkonen@helsinki.fi), Geoffrey K Aguirre[3], Toni P Saarela[2]; [1]University of Helsinki, [2]Durham University, [3]University of Pennsylvania

Background. Different material attributes may be used as cues to identify object properties, but little is known about cue integration in material perception. We studied the behavioral and neural integration of color and gloss cues for ripeness judgements. Methods. 11 observers participated in four sessions of psychophysics and fMRI. Stimuli were fruit-like, computer-rendered 3D shapes that varied in color, glossiness, or both. We created a "ripeness space", ranging from unripe (green and/or matte) to ripe (red and/or glossy) stimuli, scaled for each observer with their discrimination thresholds for the individual cues.

To quantify integration, we measured discrimination in a joint color-and-gloss condition. A fourth, mixed condition, interleaved the single-cue and joint conditions to investigate the effect of external uncertainty. Thresholds were measured using a single-interval classification task and defined as the standard deviation of a cumulative Gaussian fit to the probability of responding “ripe”. BOLD responses for the four conditions were collected while observers performed the same task in an fMRI scanner. We extracted linear adaptation effects and neural integration from occipito-temporal regions of interest (ROIs: V1-V4, LOC, FFA, control region PPA), localized with a combination of anatomical and functional methods. Results. Observers integrated color and gloss cues for ripeness judgments, evidenced by decreased thresholds in the joint, compared to single-cue, conditions. External uncertainty adversely affected performance in single-cue (but not joint) conditions, consistent with an optimal task strategy. All ROIs except PPA showed linear adaptation for color and gloss. Most of these areas showed significant cue integration, especially with no external uncertainty. Behavioral and neural integration correlated significantly in functionally defined color- and gloss-selective areas, but not in early visual cortex. Conclusions. Observers are able to integrate cues over two material attributes in a real-world task. This integration seems to be mediated by mid-level visual cortex.

Acknowledgements: This project was funded by the Academy of Finland grant 319404

This talk will be presented in Live Talk Session 3, Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Thank you for your interest in our work. If you have any questions, please contact me at maria.olkkonen@helsinki.fi.

Abstract ID: 517

Temporal dynamics of illumination perception: Can we see daylight changes?

Talk Presentation - *Topic area: Color, Light and Materials*

Ruben Pastilha[1] (rubenpastilha@gmail.com), Gaurav Gupta[1], Naomi Gross[1], Anya Hurlbert[1]; [1]Newcastle University

Little is known about human sensitivity to changes in illumination spectra over time. Illumination changes are usually represented as simplified stimuli with non-natural abrupt changes, and the few studies using uninterrupted naturalistic changes (e.g. Kong et al., 2019; Linnell & Foster, 1996) are not specifically concerned with measuring perceptual sensitivity to these. Yet temporal changes in illumination are ubiquitous; natural light, in particular, varies in color temperature and irradiance through the day. Is human vision tuned to these changes? Here we aimed to determine the minimum detectable velocity of chromaticity change of daylight metamers in a naturalistic immersive environment. The main stimulus was a continuous change in global illumination chromaticity along the daylight locus in warmer or cooler directions, away from a base light to which the observer first adapted. Four base lights were tested (CCT: 13000 K, 6500 K, 4160 K, and 2000 K). All lights were generated by spectrally tunable overhead lamps as smoothest-possible metamers of the desired chromaticities. The duration of the change stimulus was fixed at 10 s while its magnitude varied across trials for threshold estimation. Results: For 22 participants, mean change detection thresholds range from 1.5 to 0.2 $\Delta E/s$, depending on base chromaticity and chromatic direction of change. There was a significant main effect of base illumination ($p<0.001$). For the most extreme base lights (13000 K and 2000 K) sensitivity to changes towards neutral was significantly lower than the opposite direction. This result supports the notion that the visual system encodes a neutral-daylight illumination prior. The slowest change detected by the observers was about 10 times faster than the fastest changes of real daylight. We conclude that, although people are generally aware of color temperature changes in daylight, they are unable to sense these directly, and more likely build awareness through higher-level cognitive processes.

Acknowledgements: This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 765121.

This talk will be presented in Live Talk Session 4, Monday, 22 June, 4:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1496

Color, Light and Materials: Adaptation, constancy, appearance

Are there four, six, or seven unique hues?

Poster Presentation - *Topic area: Color, Light and Materials: Adaptation, constancy, appearance*

Christopher Tyler[1] (cwt@ski.org); [1]Smith-Kettlewell Eye Research Institute, [2]City University of London

Rationale. Newton originally identified seven distinct hues in the rainbow, whereas the predominant choice of current color theory is four unique hues, following the four poles of Hering's Opponent Color Theory. This coding is brought into question by the complementary colors of the CMYK system and of color afterimages, in which each corner of the triangular red/green/blue (R/G/B) color space has a distinct complementary color (cyan, magenta and yellow, respectively), supported by a reanalysis of color opponency in neurophysiological data (Pridmore, 2013). This sextet of unique hues is further supported by a new demonstration of luminance compression of the cone signal modulation in the color circle, to equalize the two interleaved trios and provide six dominant colors. Methods. To assess afterimage colors, test patches of 45 cd/m2 spanning the color gamut (R, G, B, R+G, G+B, and B+R) were viewed on an equiluminant background for 10 s to the left of fixation and replaced with an outlined blank comparison patch to the right in repeated 2 s cycles, whose color was adjusted in hue, saturation or intensity relative to match the afterimage at left. Results. Strongly saturated afterimages were obtained. To a tight specification, the afterimage CIE coordinate lines intersected at the chromaticity neutral point, highly distinct from the yellow balance point for the red/green opponent system. Afterimages thus conform to a complementary, rather than opponent, color organization consistent with each of the three primary colors (red, green and blue) having a distinct complementary counterpart (cyan, magenta and yellow, respectively), and vice versa. Conclusions. These results suggest that human color perception should best be characterized by six unique hues corresponding to the complementary pairings, rather than the four unique hues implied by the Hering opponent processes, which are not accurately supported by many forms of data.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 273

Color, Texture, and Multi-step Filling-in by Contour Adaptation

Poster Presentation - *Topic area: Color, Light and Materials: Adaptation, constancy, appearance*

Hiroki yokota[1] (hirokiyokota.1992.0327@gmail.com), Seiichiro Naito[1]; [1]Ayrom.inc, [2]ex-Tokai University

Purpose: We investigated underling mechanisms of “Contour adaptation Filling-in.” Our questions were: (1)difference between achromaticity and chromaticity, (2)difference between textured and uniform target area, (3)possibility of multiple step filling-in, and (4)resolving conflicting filling-ins by line segments. Method: “Contour adaptation Filling-in” procedure was that: After 6 second empty fixation, 5s contour adaptation was presented, and then the disappearance of test figure was judged in the next 1s. The test figures were 12 degree diameter annulus or their variants for specified purposes. The background and test figure were near equiluminant, or similar hue or saturation. The adapting contours were the boundaries of annulus with 5Hz flicker. For the question(1), we changed the duration of the target annulus presentation, e.g. 5s meant that during whole 5s adaptation the target was presented together with flicker, 1s meant that the target was presented only for the last 1s of adaptation. For (2), we presented the annulus with textures such as random dos. For (3), the test figure was the concentric annuli with step change brightness or color whose differences were small enough to disappear by the adaptation. For (4), the stimulus equipped with two conflicting filling-ins, e.g. light-gray and dark-gray. Results: (1)Filling-in of colored target needed a few seconds presentation during adaptation, while the achromatic filing-in did not. (2)Textures in uniform target figure survived filling-in. (3)Whole concentric boundaries were disappeared. Continuous gradation was observed. (4)On the conflicting conditions, the filling-in was not successful. With a separating line segment between conflicting areas subjects observed two uniform areas. Conclusions: “Contour adaptation filling-in” of uniform, color, and texture features seemed to include different mechanisms. Successful multi-step filling-in suggested that the filling-in functioned locally. The continuous gradation result meant that the filling-in was not simply to neutralize two neighboring areas. The filling-in would be dynamic spatial operation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

You could watch the demo about this poster (Experiment2-Experiment7).

Abstract ID: 492

Developmental changes in colour constancy and the use of daylight illumination priors

Poster Presentation - *Topic area: Color, Light and Materials: Adaptation, constancy, appearance*

Rebecca Wedge-Roberts[1] (rebecca.j.wedge-roberts@durham.ac.uk), Stacey Aston[1], Robert Kentridge[1], Ulrik Beierholm[1], Marko Nardini[1], Maria Olkkonen[1,2]; [1]Durham University, [2]University of Helsinki

Color constancy – the ability to judge surfaces as having an unchanging reflectance under changing illuminations – is necessary for stable object recognition. Whilst many studies have investigated color constancy in adults, its developmental trajectory remains unknown. Here we ask whether daylight illumination priors, proposed to aid constancy, might depend on learning through experience. To study the development of color constancy, and use of daylight priors in childhood, we created a novel child-friendly color-matching task. Fifty-two adults and 65 6-11 year-old children saw a dragon's favorite colored sweet under a neutral illumination (D57). On the other side of the display, they picked a match from an array of eight sweets, containing a reflectance match (color constant) and a tristimulus match (color inconstant) under either a blueish/yellowish illuminant (typical daylights), or reddish/greenish illuminant (atypical daylights). Experiment 1 used 2D patches, whereas Experiment 2 used more realistic 3D rendered objects. In Experiment 1, children had significantly higher color constancy indices (CCIs) than adults ($p<.001$). Furthermore, CCIs decreased with age during childhood (linear regression combining all illuminants, $p<.001$). In Experiment 2, there was no significant overall difference between adults and children, but a smaller but significant change with age ($p=.041$). There was also a significant age group x illuminant interaction, in which adults had slightly lower CCIs than children under blueish, reddish, and greenish illuminants but higher under yellowish. By 6 years of age, children have well-developed color constancy, with adult-like performance when using realistic 3D stimuli. The results of Experiment 1 are opposite to those predicted by color constancy developing during childhood, but this may be influenced in part by different strategies used by adults and children. Children's differing pattern of performance across illuminants - including worse for yellowish - partially supports the possibility that they are still developing a daylight prior.

Acknowledgements: This project was funded by the Leverhulme Trust Research Project Grant RF010103

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1106

Do we perceive color "cost-free" in peripheral vision? An investigation of color phenomenality across the visual field

Poster Presentation - *Topic area: Color, Light and Materials: Adaptation, constancy, appearance*

Kendra Westmoreland[1] (kwestmoreland@ufl.edu), Anya Preston[1], Kiara Lolo[1], Callie Mims[1], Nicholas Rosario[1], Brian Odegaard[1]; [1]University of Florida

Previous research has claimed that human observers perceive color “cost-free” outside focal attention (Bronfman et al., Psychological Science, 2014). Specifically, it has been shown that if observers are cued in advance to report a specific row from a briefly-presented 4x6 grid of colored letters, they can report color variability (a summary statistic) for both cued and non-cued rows of letters without impairments to working memory performance. In this study, we asked a simple question: does this “cost-free” phenomenon for color variability perception extend across the visual field? First, we replicated these findings using a standard 4x6 letter grid, presented in foveal and perifoveal regions of space. Next, in our second experiment, we modified the letter grid to probe peripheral vision, using a ring of letters to investigate if attending to one quadrant of the ring impacted color variability reports for the other three sections of the circle. Our results showed that while color variability performance for the cued region remained at similar levels to Experiment 1, color variability perception for non-cued rows decreased significantly, but remained above chance-level performance. Moreover, working memory performance for letters in the cued row decreased when color variability reports for non-cued rows were required. These results support three conclusions: (1) color variability perception is not “cost-free” in peripheral vision, as spatial attention to one region results in deficits in reporting this summary statistic in other regions; (2) color variability performance decreases in peripheral vision but remains above chance, indicating that minimally-attended peripheral regions retain some capacity for color perception; (3) tradeoffs exist between working memory performance and the capacity to report color variability in minimally-attended regions of space. These results provide important evidence for current debates on richness of peripheral vision, and support the idea that summary statistical perception may require attentional resources.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 393

Unique yellow and other special colors seen by deuteranomalous trichromats

Poster Presentation - *Topic area: Color, Light and Materials: Adaptation, constancy, appearance*

Delwin Lindsey[1] (lindsey.43@osu.edu), Lindsey Hutchinson[1], Angela Brown[1]; [1]The Ohio State University

Color appearance in anomalous trichromats may be surprisingly similar to that of color normal (CN) observers, despite the presence of an anomalous L- or M-photopigment. One possible explanation is renormalization of the spectrally-opponent mechanisms that contribute to color appearance (see: Webster, et al. 2010; Boehm, et al., 2014). Here, we explore the normalization process by studying unique yellow (UY) settings of deuteranomalous trichromats (DAs). Three DAs (match-ranges=3, 9, and 15 Nagel-I units) and 11 CN observers set UYs by adjusting 2-deg, 18 cd/m^2 colored disks flashed at 0.5 Hz within a steady 12 cd/m^2 gray surround. The target colors fell on the maximum color circle, centered near white, of a wide-color-gamut color monitor (Eizo CG276). All observers also made UY settings by mixing 540nm and 670nm primaries in the Nagel anomaloscope. On the monitor, DAs' UY settings were tightly clustered and fell **within** the range of CN settings, but DAs' anomaloscope UY settings had more **green** than those of CNs. Also, Rubin’s (1961) 32 DAs adjusted monochromatic lights to **redder** settings (583nm) than CNs (577nm). All these seemingly disparate results are well accounted for quantitatively by one-time rescaling of L/ M’ cone weights of Ingling & Tsou’s (1975) color-normal r-g color-opponent spectral sensitivity function, then re-balancing the color-opponent sub-stages to produce a null response for an equal-energy spectrum. We have extended our empirical studies to other special colors viewed within gray surrounds: unique red, green, and blue, plus four “balanced” binary colors (e.g., “an orange that is equally reddish and yellowish”, cyan, purple, and lime). All but one single DA color setting fell within the CN setting-ranges. These results suggest that, despite the presence of an anomalous M-photopigment, renormalization produces a perceptually-scaled DA hue space that closely approximates CN space (see Bonnardel, 2006; Boehm, et al., 2014 for related work).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1249

Color, Light and Materials: Lightness, brightness, preference

A model of lightness perception guided by probabilistic assumptions about lighting and reflectance

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Richard Murray[1] (rfm@yorku.ca); [1]York University

Lightness perception is the ability to perceive black, white, and gray surface colors in a wide range of lighting conditions and contexts. This is a fundamental ability, but how the human visual system computes lightness is not well understood. Here I show that several key phenomena in lightness perception can be explained by a computational, probabilistic graphical model that makes a few simple assumptions about local patterns of lighting and reflectance, and infers globally optimal interpretations of stimulus images using belief propagation. I call the proposed model MIR, for 'Markov illuminance and reflectance'. To simplify the modelling problem, I consider stimuli on a 16 x 16 pixel grid. Within this constraint one can create many challenging lightness phenomena. To provide a basis for model testing, I measure human lightness percepts in several strong, well known lightness illusions adapted for a 16 x 16 grid. MIR's probabilistic assumptions are reasonable and generic, including for example that lighting intensity spans a much wider range than surface reflectance, and that shadow boundaries tend to be straighter than reflectance edges. Like human observers, MIR exhibits lightness constancy, codetermination, contrast, glow, and articulation effects. It also arrives at human-like interpretations of strong lightness illusions that have challenged previous models. I compare three current brightness models to MIR: ODOG, a high-pass model, and a retinex model. MIR outperforms these models at predicting human lightness judgments, with the exception that ODOG (unlike MIR) can account for brightness assimilation effects. Thus a probabilistic model based on simple assumptions about lighting and reflectance gives a good computational account of lightness perception over a wide range of conditions. This work also shows how graphical models can be extended to develop more powerful models of constancy that incorporate features such color and depth.

Acknowledgements: NSERC

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

This work is in press at Journal of Vision. You can find a preprint here: yorku.ca/rfm/pub/2020jov.pdf.

I have a postdoctoral position available in my laboratory, with a start date in late 2020 or early 2021. If you have strong computational skills and are interested in finding creative ways to adapt methods from machine learning and computer vision to develop better models of human vision (particularly lightness perception), feel free to contact me (rfm@yorku.ca).

Abstract ID: 1294

An evolutionarily-inspired method to assess the relative importance of features in a complex parameter space.

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Tamara Watson[1] (t.watson@westernsydney.edu.au), Josh Brunker[1], Raghba Latifi[1], Matthew Patten[1];
[1]Western Sydney University

Complex images represent a high-dimensional challenge when trying to understand which aspects of their appearance are important when making aesthetic decisions. We developed a method to efficiently map the relative importance of many parameters simultaneously via an evolutionary selection of parameter values. Using this method we aimed to establish the features contributing to appealing (experiment 1) or aversive (experiment 2) aesthetic experience. The experiment used complex, computer-generated, flower-like stimuli defined by more than 20 attributes that included colour, symmetry, angularity and number of petals. Participants were shown a selection of six stimuli and were asked to identify both the most and the least appealing (exp 1), threatening (exp 2a) or disgusting (exp 2b) stimuli on each trial. The first stimulus set was generated by selecting, at random, a value for each of the available parameters for each stimulus. After each set of responses the presentation likelihood of the attributes of the most/least appealing stimuli were increased/decreased, respectively. The next set of six stimuli were generated via random value selection from parameters with the newly-adjusted display likelihoods. Participants completed 80 trials comprising two interleaved processes. We established the stability of each participant's selection through the correlation of the display probability between the two processes and assessed between-participant agreement via bootstrapping. Symmetry, self-similarity and luminance contrasts with low spatial frequency were identified as components of appealing stimuli. Blotchy and brown petals were selected as disgusting while complexity, sharpness and symmetry were selected as threatening. These results accord with previous research into the visual characteristics of aesthetic experience. We thus show that our method can quickly and accurately ascertain the important aspects of complex visual stimuli in a variety of perceptual decisions.

Acknowledgements: Supported by the Australian Research Council DP170101537

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 496

Color value of virtual spaces can affect on sadness in major depressive disorder.

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Fatemeh Akrami[1] (fatemehakramii@gmail.com), Amirhossein Ghaderi[2]; [1]Iran University of Medical Science, [2]York University

Visual preferences of colors are supposed to be different between people who suffer from major depressive disorder (MDD) and non-depressed people (Nolan et al, Perceptual and Motor Skill, 1995). However, this issue has not been investigated in relation to various dimensions of colors (hue, saturation, and value). Here, we investigated whether the preferences of value of the color are affected by depression, while the hue and saturation are controlled. Twenty MDD people and 37 non-depressed individuals participated in this study. 3D MAX was used to design an animation and participants changed colors (RGB model). We selected 18 hues (between 0 and 255/constant intervals, maximum saturation). In each hue we ask them to select the value (0 to 255) of colors in response to four questions (what is your preference to select a color; 1) for your consulting space?, 2) as your favorite color?, 3) that make you happy?, 4) that make you sad?), Bonferroni multiple-comparison correction indicated in response to question four, both groups selected low values but the MDD group selected significantly higher values than control in several hues (green H= 90,120,150, and yellow H=60). In the first question, they selected significantly lower value of color in just one hue (orange H=30). In response to question three, the MDD group chose significantly higher value just in one case (red H=0). These results suggest that the most significant differences are found in selection of colors in response to negative emotions (sadness). This is consistent with previous studies that suggested colors can affect on sadness in MDD (Hanada, Color Research & Application, 2018). But, more precisely, this study suggested that color values of different hues in an architectural space can affect on sadness in MDD. More investigations with neuroimaging approaches are required to find the neural basis of this mechanism.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 927

Equivalent noise characterization of human lightness constancy

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Vijay Singh[1] (vsin@sas.upenn.edu), Johannes Burge[2], David Brainard[2]; [1]North Carolina Agricultural and Technical State University, [2]University of Pennsylvania

An important goal for vision is to provide stable perceptual representations of task-relevant scene properties (e.g. target object size, shape, reflectance) despite variation in task-irrelevant scene properties (e.g. illumination, reflectance of other nearby objects). To study such stability, we measured how variation in a task-irrelevant scene property affects threshold for discriminating changes in a task-relevant property. Four subjects viewed computer-rendered images of a 1-degree sphere, within a 2-degree scene containing naturalistic background objects. The sphere's reflectance was spectrally flat but varied in albedo. On each trial, two images of the scene were presented in sequence and subjects indicated which 0.25s interval contained the sphere with higher albedo. Across intervals, the reflectances of the background objects were randomized by sampling from a probabilistic model of naturally occurring surface reflectances. This reflectance distribution was varied systematically by applying a scalar to its covariance matrix. Discrimination thresholds were measured as a function of the scalar. When plotted as a function of log covariance scalar, log squared thresholds were initially constant, and then rose approximately linearly with a slope of 0.20 +/- 0.03. The equivalent noise, the log covariance scalar value at which threshold elevation began, was -2.08 +/- 0.21. We compared the data to predictions of a recently published computational model of lightness constancy. Model thresholds were aligned with human thresholds at covariance scalar equal to zero by adding noise to the computational observer estimates. The model predicted human equivalent noise to reasonable approximation (model value, -2.44), but model thresholds increased more rapidly than those of the subjects (model slope, 0.38). Our experiment characterizes the intrusion that background variability has on perceived object lightness. Our computational model accounts reasonably for the equivalent noise, but is challenged by the low slope of threshold rise shown by human subjects.

Acknowledgements: NIH EY10016 (DHB), NIH R01-EY028571 (JB)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

Contact Vijay Singh vsingh@ncat.edu for further information. The slides in the video can be requested via email.

Abstract ID: 610

Heterochromatic brightness and luminance

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Alice C Chadwick[1] (alice.chadwick@psychol.uni-giessen.de), Matteo Toscani[1], Jing Chen[2], Karl Gegenfurtner[1]; [1]Justus-Liebig Universitat Giessen, [2]Shanghai University of Sport

Luminance is the standard for measuring the intensity of lights, and the luminous efficiency curve V(l) defines how radiance is weighted across different wavelengths. Yet, luminance is defined mainly by procedures that emphasize high temporal (minimum flicker) or high spatial (minimum border) frequencies, where the S-cones are known to be much less sensitive. It has long been known that human heterochromatic brightness perception deviates markedly from luminance. For example, colorful patches look brighter than achromatic patches of equal luminance, and hue also has an effect on brightness (the Helmholtz-Kohlrausch effect). Some appearance models take this into account, but they typically take luminance as their starting point and typically are computationally rather complex. We collected behavioural data from 16 participants making judgements of perceived brightness. Participants ranked, in each trial, 16 patches varying in hue, saturation and intensity. We compared the empirical rankings with that predicted by luminance, a simple non-linear model taking the weighted maximum of three color channels (maxRGB), and several common color appearance models. The simple nonlinear model maxRGB predicts the rankings significantly better than luminance (82% correct predictions for maxRGB compared to 77.8% for luminance ($t(15)=4.56$, $p<0.0005$). The various color appearance models have intermediate accuracies. Visible radiance performed about equally well as luminance. The weights fitted to the maxRGB model differ strongly from the weights used by luminance. They closely agree with weights describing perceptually unique yellow. We conclude that a simple non-linear model can serve as an improvement over the V(l) defined luminance for describing the brightness of hetero-chromatic stimuli.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

Thank you for your interest in our poster. If you have any questions or would like to speak with us about the project, please feel free to contact me at Alice.Chadwick@psychol.uni-giessen.de

Abstract ID: 1169

How colorful is visual experience? Evidence from gaze-contingent virtual reality

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Michael Cohen[1,2] (michaelthecohen@gmail.com), Thomas Botch[3], Caroline Robertson[3]; [1]Amherst College, [2]MIT, [3]Dartmouth College

As soon as an observer opens their eyes, they have the immediate impression of a rich, colorful experience that encompasses their entire visual world. Here, we show that this impression is false. We used gaze-contingent rendering in immersive virtual reality (VR) to reveal the limits of color awareness during real-world visual experience. We exploited recent developments in head-mounted VR to immerse observers (N=160) in dynamic, audio-visual, real-world environments (e.g., a symphony rehearsal, etc.). Observers naturally explored these environments in whatever way they chose via saccades and head turns. Meanwhile, we monitored their gaze with in-headset eye tracking. Then, with observers having no expectation that anything different was about to occur, we altered the visual environments such that only the parts of the scene they were looking directly at were presented in color. The rest of the scene in the periphery was entirely desaturated. Overall, we found that observers routinely failed to notice when color completely vanished from the overwhelming majority of their visual world. In the most extreme case, almost a third of observers failed to notice when less than 3% of the visual world was presented in color, while everything else was desaturated. However, when those observers were shown the same displays a second time and instructed to attend to their periphery, every observer immediately detected the altered periphery and was astonished that they did not previously notice. In a second study (N=20), we measured color detection thresholds using a staircase procedure while observers attended to the periphery. Once again, we found that observers were unaware when a large portion of their field of view was presented in greyscale. Together, these results provide the first measurements of color awareness during active, naturalistic viewing conditions, and show that our intuitive sense of a rich, colorful visual world is largely incorrect.

Acknowledgements: his study was supported by a National Science Foundation Collaborative Research Award (#1829470) to M.A.C and a grant from the Nancy Lurie Marks Family Foundation to C.E.R and the donation of a Titan V GPU by the NVIDIA Corporation to C.E.R.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Here's a link to the paper in PNAS if you're interested!

http://www.michaelacohen.net/uploads/5/9/0/7/59073133/1922294117.full.pdf

Abstract ID: 917

Lightness perception in a flash

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Sae Kaneko[1] (sakaneko@riec.tohoku.ac.jp), Alan Gilchrist[2]; [1]Tohoku University, [2]Rutgers University

A gray square placed on a black background appears lighter than the same square placed on a white background (simultaneous lightness contrast). Kaneko and Murakami (2012) showed that the simultaneous contrast was stronger when the stimulus duration was 10 ms compared to 500 ms. In this study we tested the effect of exposure time on lightness perception in scenes more complex than the stimuli used by Kaneko & Murakami (2012). Subjects viewed three kinds of display: (1) simultaneous lightness contrast, (2) Bressan's dungeon illusion (Bressan, 2001), and (3) Gilchrist's two-room arrangement (Gilchrist, 1977), and made matches to the target squares using a Munsell chart. Viewing duration was either long (unlimited) or short (~15 ms using a camera shutter). We found that with short exposure, the simultaneous contrast illusion was four times larger than with long exposure, confirming the early report by Kaneko and Murakami (2012). The dungeon illusion, a reverse-contrast illusion at long exposure, reversed direction, becoming a conventional contrast illusion at short exposure. In Gilchrist's two-room arrangement, at long exposure, the target appeared black in the far lighted plane and light gray in the near shadowed plane. But this difference was greatly reduced, or eliminated at short exposure, suggesting the absence of a depth effect. While the long exposure results are consistent with anchoring theory (Gilchrist, 2006) and its emphasis on depth and grouping factors, the short exposure results are consistent with Wallach's (1948) ratio theory. That is, targets are seen merely in relation to their retinal surround.

Acknowledgements: Supported by JSPS KAKENHI (JP18K13365), Building of Consortia for the Development of Human Resources in Science and Technology

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 954

Shape-color associations across cultures

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Aurore Zelazny[1,2,3] (aurore@hum.aau.dk), Thomas Alrik Sørensen[1,2]; [1]Centre for Cognitive Neuroscience, Aalborg University, [2]Sino-Danish Center for Education and Research, Beijing and Aarhus, [3]University of the Chinese Academy of Sciences, Beijing

Kandinsky (1912), proposed fundamental links between shapes and colors; circles are associated with blue, triangles with yellow, and squares with red. A century later, these associations were experimentally tested, pointing out different association tendencies compared to the original suggestion by Kandinsky; circles being yellow, triangles red, and squares blue (Jacobsen, 2002). Furthermore, Kandinsky's original shape-color associations do not yield any priming effect (Kharkhurin, 2012), further weakening the original claim. Widening the range of possible color responses from 3 to 40 colors, Albertazzi et al. (2012), found significant tendencies in which colors people tend to associate to particular shapes. The circle tends to be associated with red and yellow, the triangle with yellow, and the square with both red and blue. In two follow-up studies Chen and colleagues (2015, 2017) demonstrate similar tendencies in groups of Japanese observers (i.e. circles tend to be red, triangles are yellow, and squares are blue). We believe that some of the differences between studies may very well be due to different cultural backgrounds. Indeed, Jacobsen (2002), Kharkhurin (2012), Albertazzi et al. (2012) and Chen et al. (2015, 2017) respectively tested German, American, Italian, and Japanese participants. Also, these studies limit color responses to 3 or 40 color chips, which may influence the possible reports of shape-color preferences. Jacobsen (2002) suggested that environmental cues influence the shape-color associations (e.g. red from triangular warning sign, and yellow from the sun). Here we investigate these environmental/cultural differences for five basic shapes (circle, triangle, square, hexagon, and pentagon) using a full color wheel which allow observers free associations. In line with previous studies, preliminary results (N = 3500) reveal shape-color preferences for all shapes. Interestingly, specific shape-color distastes are also present. Both shape-color attraction and repulsion can unveil new underlying influences and mechanisms for shape-color associations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 678

The appearance of depictions

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Yuguang Zhao[1] (y.zhao-5@tudelft.nl), Huib de Ridder[1], Maarten Wijntjes[1]; [1]Delft University of Technology, Perceptual Intelligence Lab

Similar objects can appear different because of natural or man-made variations. Depictions of objects also exhibit appearance differences. If two painters paint the same object, the appearance difference can be called style. Artists use colors, shading, brushstroke etc., to give their work a unique signature. However, it is implicit and difficult to quantify. In this study, we investigated how humans perceive different depiction styles. In an online experiment, we used (fragments of) paintings as stimuli. The creation years of the paintings varied from the 17th to 20th century. There were four sets of stimuli: 10 flower paintings, 10 flower fragments, 16 apple fragments, and 16 peach fragments. In each trial, two stimuli were presented side by side. After five practice trials, participants were asked to rate depiction style differences on a 0-100 scale, from “not so different” to “very different”. 80 participants completed the rating task (20 for each set). To quantify inter-observer agreement, we computed correlations between individual and mean data. We found that on average, observers agreed most on peaches (r=0.75) and least on flower fragments (r=0.51). Multidimensional scaling analysis was then performed to position the stimuli in a perceptual space. After calculating stress values, 2D spaces were the best fit, except for peaches (1D). In the 2D perceptual space of apples, a clear gradient of creation years was present. This confirms that style changes with time. Furthermore, for the flower fragments, two clusters emerged from a single cluster in the whole-painting condition, suggesting that participants were using different criteria to judge style differences. We showed that people are capable of distinguishing different depiction styles. We found that one of the underlying criteria is creation year. Furthermore, the scale difference for the flower paintings suggest that brush strokes contribute to these perceptions.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1741

Visual evoked potentials related to the emotional value of natural surfaces

Poster Presentation - *Topic area: Color, Light and Materials: Lightness, brightness, preference*

Narumi Ogawa[1], Isamu Motoyoshi[1]; [1]Department of Life Sciences, The University of Tokyo

Humans can easily judge not only the color or texture of a surface but also its emotional value such as pleasantness or disgust. Recent psychophysical studies suggest that human observers can infer the emotional value of natural surfaces from low-level image statistics and that observers can do so quickly and somewhat independently from the recognition of material category (e.g., Motoyoshi & Mori, 2016). To investigate the neural dynamics involved in such visual emotional processing, we measured visual evoked potentials (VEPs) for 150 images of natural surfaces presented for 500 ms separated by blanks of 750 ms. At each temporal point, we computed the correlation between VEP and the subjective rating for each surface that ranged from unpleasant (-4) to pleasant (4). The analysis revealed that large occipital VEPs (O1/O2) correlate with positive emotional values at 150-300 ms from stimulus onset and that frontoparietal potentials (Cz) correlate with negative emotional values at latencies less than 120 ms. In line with previous psychophysical data (Motoyoshi & Mori, 2016), an analysis of low-level image statistics showed that negative emotional values were associated with high luminance/color contrast at middle spatial frequencies and with high cross-orientation energy correlation at high spatial frequencies. Image statistics were partly correlated with emotion-related components in occipital (O1/O2) and parietal (Cz) cortex. The results suggest that emotion-related low-level image features of visual textures produce neural responses related to negative emotions in frontoparietal regions even more rapidly than in the early visual cortex.

Acknowledgements: Supported by Commissioned Research of NICT (1940101) and by JSPS KAKENHI JP15H05916, JP18K19801

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 645

Color, Light and Materials: Material perception

A Database of Painterly Material Depictions

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

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Painters depict materials by utilizing an implicit knowledge of human material perception. To enable studies of this implicit knowledge, we created a database of paintings annotated with bounding boxes of various depicted materials (e.g., fabric, stone, wood, etc.). First, we collected a set of nearly 20K paintings (primarily Old Masters) from online open-access galleries of nine internationally renowned art institutions. For 14 material categories, we asked human annotators from Amazon Mechanical Turk (AMT) to indicate the presence of each material within each painting. On average, we find 6.4 unique materials per painting. Skin and fabric were the most frequently depicted materials, while ceramic and food were the least frequent. Additionally, we calculated material co-occurrence correlations which show that, for example, when skin is present within a painting, food is less likely to be depicted within the same painting and vice-versa ($r = -.59$). Next, we selected 15 skilled AMT annotators to annotate more than 100k bounding boxes of the 14 materials. This allowed us to identify the spatial location within paintings where materials are depicted. For example, we find that glass is more often depicted within the top-left quadrant of the painting, which could be related to art-historical literature noting that light is often depicted as originating from the top-left (perhaps through a glass window). In the next step, more detailed material labels will be obtained, for example fabrics will be refined as silk or cotton or wool, etc. This in-depth dataset of material depictions can enable various perceptual, computational and historical analyses that could enable a deeper understanding of material perception and depiction.

Acknowledgements: This work is part of a VIDI program with project number 276-54-001, which is financed by the Netherlands Organization for Scientific Research (NWO). This work is also supported by an NSERC PGS-D.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1127

Manipulation of glossiness perception by contrast enhancement of high spatial frequency components

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

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Our visual system can perceive glossiness not only from high-luminance regions (e.g., specular highlights) but also from low-luminance regions of object images (Fleming et al., 2003; Kim et al., 2012). The authors recently reported that high spatial frequency components, such as luminance edges, on a glossy object surface well correlated to magnitude of perceived glossiness not depending on specular highlights (Kiyokawa et al., 2019). Here, we examined whether emphasizing the contrast of high spatial frequency components increases perceived glossiness in two psychophysical experiments. In the first experiment, we quantified dependency of perceived glossiness on specular highlight. The stimuli were 108 glossy object images with and without specular highlights (referred to as Full and Dark condition, respectively) generated by a computer graphics software, Mitsuba. The observers rated perceptual glossiness on these stimuli. On the basis of the rating results, the stimuli were divided into two groups: the high highlight-dependency (HHD) group, in which scores were significantly larger in Full condition than in Dark condition, and the low highlight-dependency (LHD) group, in which scores were comparable between the highlight conditions. In the second experiment, high spatial frequency contrast in the stimulus images were enhanced with a Laplacian-based filter with different strengths. Two images with different enhancement strengths were simultaneously presented side-by-side, and the observers judged which image seemed glossier in the 2AFC manner. The results showed that perceived glossiness increased with strengths of high-frequency contrast enhancement in both highlight conditions. However, in Dark condition, the glossiness enhancement effect of the filtering was significantly stronger in the LHD group than in the HHD group. These results suggest that enhancement of high-frequency contrast is effective for manipulating the strength of perceived glossiness and, in particular, the effects are more prominent for object images on which glossiness perception does not depend on specular highlights.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 364

Material rendering property of illumination: relationship between illumination statistics and perception

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

Daisuke Kondo[1], Hayato Fujita[1], Isamu Motoyoshi[1]; [1]Department of Life Sciences, The University of Tokyo

Recent psychophysical studies show that the perception of surface material properties such as glossiness and color strongly depend on the spatial structure of illumination statistics, or "lightfield". In the present study, we systematically investigated the relationships between illumination statistics and perceived surface qualities in order to determine the characteristics of the lightfield that enhance the material appearance of surfaces – a term we dub the 'material rendering property' of illumination. In a series of psychophysical matching experiments, 9 observers inspected computer-generated images of bumpy objects under 21 different natural lightfields (both outdoor and indoor scenes selected from a large database) and adjusted one of the test's perceived surface properties – glossiness, mesoscopic roughness, or bump sharpness (7 levels for each dimension) – to match the perceived surface property of the reference object. For example, on each trial in the 'glossiness' experiment, the observers freely viewed the reference object of a given specular reflectance (e.g., 0.5 %) under a particular lightfield and adjusted the specular reflectance of the test object under a fixed lightfield (Eucalyptus). For each lightfield, we computed two classes luminance subband image statistics, namely moment statistics (contrast, skewness, and kurtosis) and energy correlations across subbands. We then calculated correlations between class statistics on the one hand and variations in matched glossiness across different specular reflectances on the other. The analysis showed that variations in perceived glossiness were highly correlated with key statistical features of the lightfield including contrast, skewness, kurtosis, and cross-orientation energy correlation. Similar correlations were obtained for mesoscopic roughness and bump sharpness. Together, results suggest that light environments with high spatial contrast, skewness, kurtosis, and cross-orientation energy correlations (e.g., bright, sparse, and spotty features) tend to have a high material rendering property.

Acknowledgements: Supported by the Commissioned Research of NICT (1940101) and by JSPS KAKENHI (JP15H05916, JP18K19801)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 647

Object recognition based on visual shape can facilitate material recognition

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

Eiji Kimura[1] (eiji.kimura@chiba-u.jp); [1]Chiba University

Some everyday objects are made of a particular material in most cases (e.g., cotton T-shirts). This high association between objects and material may mediate mutual interaction between object and material

recognition. This study investigated using a priming paradigm whether object recognition based on visual shape can affect material recognition. In Experiment 1, the prime was a line drawing of an object without any color and texture information. Twenty prime objects were selected that are highly associated with one of five material categories (leather, metal, stone, wood, and cloth); e.g., a baseball glove (leather), wrench (metal), and gravestone (stone). The target was a close-up material image without any object information. The relationship between the prime and target was systematically manipulated in three conditions. In the congruent-typical condition, the target image had typical color and texture of the prime object. In the congruent-atypical condition, the material represented in the target image belonged to the same category as the one associated with the prime object but its surface properties were atypical. In the incongruent condition, the image was selected from one of the other four categories than the one associated with the prime. On experimental trials, a prime was presented for 200 msec and, after a blank of 500 msec, a target was presented for 60 msec. The target was followed by a mask of 300 msec. Observers were asked to categorize the target material in a 5AFC task. Results showed that material categorization was most accurate in the congruent-typical condition and significantly better than that in the incongruent condition. The performance in the congruent-atypical condition was intermediate. This facilitative effect disappeared, when an object name was used as the prime in Experiment 2. These findings suggested that, at least for some objects, material properties are visually, not conceptually, encoded in their representations.

Acknowledgements: Supported by JSPS KAKENHI (26285162 & 18K18686)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for your interest in my work. If you have any questions and/or comments, please contact me at eiji.kimura@chiba-u.jp.

Abstract ID: 960

Perceived force extrapolation affected by material, shape, and size of objects

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

Robert Ennis[1] (robert.ennis@psychol.uni-giessen.de), Katja Doerschner[1,2]; [1]Justus-Liebig University Giessen, [2]Bilkent University

A prevalent idea in "perception of physics (i.e., kinematics/dynamics)" experiments is that in order to predict the future position of an object, humans employ "naive physics" models. These models are essentially reduced simulations of the physical environment, in which some diminished form of the laws of motion are implemented. However, simulations are costly and an alternative, yet effective, strategy would be to implement a simple, orthogonal set of heuristics that would mimic a "naive physics" model if implemented well. Here, as our initial attempt to distinguish between the two possibilities, we tested the capacity of observers to extrapolate the effects of a force. Observers viewed videos of a flag situated outside a building and flapping in the wind. The building had a glass window, through which a stationary object hanging from a pendulum could be viewed. During each trial, observers indicated the height to which the object would swing if the walls of the building were removed and the wind could act directly on it. We varied the material (wood, glass, metal), size (small/big), and shape (cone, cube, sphere) of the objects, since all of these are relevant to how the wind would effect the motion, and the strength of the wind was varied over five roughly perceptually equally spaced steps. Observers responses increased mostly linearly with increases in wind strength and there were effects of material, shape, and size, with an interaction between material and wind strength. We find that when an object is medium size, glass and wood are seen as equally heavy and lighter than metal, but when the object is larger, responses shift and glass is perceived as heavier, as much as metal. Observers extrapolate forces, but in a way that is not always consistent with physics.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1152

Perceptual signatures of velvet and satin depicted in 17th century paintings

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

Francesca Di Cicco[1] (f.dicicco@tudelft.nl), Mitchell van Zuijlen[1], Maarten W. A. Wijntjes[1], Sylvia C. Pont[1];
[1]Delft University of Technology

The visual appearance of fabrics allows us to infer their physical properties, like a sweater feeling warm and soft. Moreover, we usually associate specific material attributes with certain materials. We performed two online experiments to find which perceptual attributes distinguish velvet from satin depicted in 17th century paintings, and how perception changes if textiles' context is removed. In experiment 1, six attributes (roughness, shininess, weight, softness, hairiness, warmth) were rated for 20 images of painted velvet and satin, shown either with context in full figure or without context as crops of the textile. Overall,

all attributes were consistently associated with velvet, except shininess which was associated with satin. PCA showed that satin and velvet in full figure condition clustered according to their distinctive material attributes. The distinction was less clear in the cropped condition. In experiment 2 we tested the influence of the choice of the cropped area on this effect by dividing the textiles into equally sized crops, resulting in around 15 crops per painting. Participants rated these crops on either softness or shininess, attributes found to be diagnostic and independent in experiment 1. A one-way ANOVA showed that crops differed significantly in shininess, but not softness perception. For each crop, we analyzed the highlights' features. Overall, shininess correlated positively to highlights' intensity and percentage of coverage, whereas softness was not correlated to the highlights' features. Other cues, like asperity scattering and folds' shape, might be related to visual perception of softness. We showed that velvet and satin possess perceptual signatures which can be used to distinguish them. We also demonstrated that if parts of a whole are isolated, their perception differ due to the local availability of cues. Further research is needed to understand if the global judgement derives from the most representative part or from an average.

Acknowledgements: This work is part of the research program NICAS "Recipes and Realities" number 628.007.005, financed by the Netherlands Organization for Scientific Research (NWO) and by TU Delft. M.W. and M.v.Z. were financed by the VIDI project "Visual communication of material properties", number 276.54.001.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 481

Relation between 3D shape and image luminance reveals materials class

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

Maarten Wijntjes[1] (m.w.a.wijntjes@tudelft.nl), Mitchell van Zuijlen[1], Francesca di Cicco[1]; [1]Delft University of Technology, Perceptual Intelligence Lab

Material properties, 3D shape and illumination conditions all contribute to the 2D (retinal) image. All three ingredients of the image formation process have previously been investigated, but we were interested in combining 3D shape perception with image information to infer material and light properties. We selected

16 painted and photographed textile samples which showed a variety of draped fabrics. For each picture, we selected 20 sampling locations where we measured the RGB color which was converted to a (relative) luminance value. These same locations were used in a gauge figure task where we used an attitude probe to quantify the perceived local slant and tilt. For this task, 8 observers participated per textile in an online experiment. If reflectance was Lambertian and the light conditions were collimated in frontal direction, one would expect a negative correlation between slant and image luminance. Although we do not assume light conditions or reflectance properties a priori, we explored whether slant/luminance correlations were related to the material class. Correlations varied between -0.5 to +0.9 and materials classes seemed to covary distinctively with these values. Negative correlations were primarily found with matte materials. Stimuli with correlations around 0 (between -0.2 and 0.3) looked like shiny satin materials. The large positive correlations were found with hairy, velvety looking materials. We did not find differences between painted and photographed textiles. Although a more complex model may reveal more accurate insights into the depicted material properties, this simple model seems to relate slant/illumination information to materials class quite well.

Acknowledgements: This work is part of project 276-54-001, which is financed by the Netherlands Organization for Scientific Research (NWO).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

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Abstract ID: 1520

Similar perception of surface gloss in the upper and lower regions of the visual field

Poster Presentation - *Topic area: Color, Light and Materials: Material perception*

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The stimulation received in the upper and lower regions of the visual field during natural viewing can often differ in its environmental origins and functional relevance. In consequence, our perception of surface properties may depend on the region of the vertical visual field that is stimulated. Here, we investigated whether the perception of a fundamental surface property, glossiness, is constant between presentations in the upper and lower regions of the visual field. Participants (n=20) viewed digital renderings of two objects (randomly-perturbed spherical geometry, Ward reflectance model, 20% diffuse reflectance, 5.2° in diameter) that were simultaneously presented in the upper and lower regions of the visual field (5.8° eccentricity) and rotated back and forth about the vertical axis for 500ms. The standard object had a specular reflectance of either 15% or 30% and was presented in either the upper or lower region of the visual field, and the comparison object had a specular reflectance that varied across trials according to an adaptive staircase. The probability of judging the comparison object as glossier was modelled as a logistic function of its log specular reflectance, and the effect of visual field location on the point of subjective equality (PSE) was the key parameter of interest. A Bayesian mixed-effects model indicated that this effect was more likely to be zero (Bayes factor of 3.8, 'moderate' evidence) than an alternative in which the size of the effect was described by a normal distribution that could scale the PSE in either direction (with 2σ approximately halving/doubling). Hence, we conclude that the gloss of the two objects was perceived similarly. This finding is consistent with perceived surface gloss being constant for stimulation at equal distances from fixation across presentations in the upper and lower regions of the visual field.

Acknowledgements: This research was funded by the Australian Government through the Australian Research Council (DP170100087 to DM)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
22 June, 2:00 am EDT America/New_York

Presenter's Message

Please email Hua-Chun Sun (hua-chun.sun@unsw.edu.au) should you have any questions or comments.
Visiting my website for more of my research
https://sites.google.com/view/huachunsun/home

Abstract ID: 167

Color, Light and Materials: Models and mechanisms

Equilibrium temporal dynamics of neon color spreading

Poster Presentation - *Topic area: Color, Light and Materials: Models and mechanisms*

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The neon color illusion reveals fundamental properties of the human visual system (Van Tuijl, 1975; Varin, 1971), as perceptual filling-in of color is thought to underlie surface completion and object recognition. Although spatial factors of neon color spreading have been extensively studied, limited research has characterized its temporal dynamics. We measured the temporal modulation transfer function (MTF) of neon color spreading. Two practiced observers with normal color vision and corrected acuity completed threshold measurements for detection of flicker for crosses (real color) and neon spreading (illusory color) in the same display. Five reference crosses and five test crosses were presented on an 8×8 black grid (2.24×2.24 deg), with the test crosses forming two chevrons pointing left and right. Each test cross was at an eccentricity of about 0.66 deg. The test crosses in the display sinusoidally flickered either between complementary red and blue (bipolar flicker), or between red and grey (unipolar flicker), and the color of the reference crosses was fixed at mid-chromaticity of the test colors. Sensitivity was measured for temporal frequencies from 0.5 Hz to 10 Hz or higher for both color conditions (unipolar and bipolar) and both tasks (judging real and illusory colors). All MTF curves for flickering crosses have higher sensitivities than the neon color MTFs at all frequencies, and nearly all MTFs have a clearly band-pass shape. For each observer the MTF for the unipolar and bipolar conditions are different in shape, suggesting possible differences in dynamics of responses to the red and blue lobes of the bipolar flicker.

Acknowledgements: This work was supported by NSF BCS-1921771.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 756

How to find a tritan line, without actually trying

Poster Presentation - *Topic area: Color, Light and Materials: Models and mechanisms*

Alex J. Richardson[1], Kassandra R. Lee[1], Michael A. Crognale[1], Michael A. Webster[1]; [1]University of Nevada, Reno

Chromatic information in the retina and geniculate is primarily encoded within mechanisms that compare signals in the L vs. M cones or the S vs. L and M cones. Accordingly these “cardinal directions” have played a central role in modern color science both for specifying chromatic stimuli and interpreting perceptual processes. Because individual observers vary widely in their spectral sensitivity, the stimuli that isolate the cardinal axes differ across observers. Procedures have been proposed for empirically determining the axes, yet these are cumbersome and rarely used, and most studies instead specify the directions based only on the standard observer. We examined how the cardinal directions depend on individual differences in the luminance sensitivity of observers, which are routinely measured. We modeled variations in spectral sensitivity based on estimates of the normal variability in lens and macular pigment density, cone optical density and spectral peak, and cone ratios. The tilt in the equiluminant plane along each axis was then compared to the chromatic rotations within this plane for a given observer. The degree of luminance tilt and chromatic rotation were strongly correlated along both axes ($r \approx 0.85$ for S; $r \approx 0.80$ for LM). Luminance sensitivity depends only on the L and M cones, but variability in the S cones had no (S) or little (LM) effect on the correlations. We conclude that individual differences in the cardinal directions can be approximated with good accuracy simply from the empirical luminance corrections that are already widely applied in studies of color vision.

Acknowledgements: Supported by EY-010834

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1606

Parametric decoding of visual colour from contralateral scalp electroencephalography

Poster Presentation - *Topic area: Color, Light and Materials: Models and mechanisms*

Jasper Hajonides[1] (jasper.hajonidesvandermeulen@new.ox.ac.uk), Freek van Ede[1], Kia Nobre[1], Mark Stokes[1]; [1]University of Oxford

Human scalp electroencephalography (EEG) can be used to measure electrical activity in the cortex and is usually thought to have low spatial resolution. Recently, research has shown that by combining activity across EEG sensors we can use multivariate analyses to decode information that includes more fine-grained spatial elements such as visual stimulus orientation, spatial location, spatial frequency, and motion direction. The decodability of other visual features, such as colour, remain less well explored. Although several attempts of decoding colours from brain activity have been successful in fMRI and more recently also in MEG, only few studies have evaluated colour decoding by means of EEG – and it often remains unclear to what extent such decoding reflects verbal labelling of distinct colours vs the parametrical and retinotopically-specific processing of colours in visual brain areas. In the current study, we presented participants simultaneously with two Gabor gratings, each with a unique colour and orientation and applied linear discriminant analysis to learn and successfully predict all four colour and orientation features. Our analyses show that both the orientation- and the colour-feature space are represented parametrically, rather than categorically, and preservation of characteristic contralateral decoding topographies (thus ruling out 'verbal labelling' as a potential explanation). We also show a robust increase in decoding performance when combining information across both EEG sensors and across time, suggesting the neural responses to different colours can be further distinguished through their unique temporal response profiles. We thus find reliable decoding of colour-specific processing in visual cortex from human scalp EEG, even when presented with multiple stimuli of different colours and at lateral locations. Unlike orientation decoding, colour decoding cannot capitalise on spatial information; therefore, it should be less biased by eye movements, opening up many new opportunities for future research.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1139

Perception of S-cone, ML-cone and achromatic contrast by awake behaving cats

Poster Presentation - *Topic area: Color, Light and Materials: Models and mechanisms*

Peter Kobor[1] (peter.kobor@aok.pte.hu), Janos Rado[1], Peter Hegyi[1], Peter Buzas[1]; [1]University of Pecs

Recently, we described the temporal characteristics of color-sensitive (blue-ON) cells in the lateral geniculate nucleus (LGN) of anaesthetized cats. Since anatomically, this pathway is heavily underrepresented compared to the achromatic channel (low S-cone and blue-ON cell density in the retina and LGN, respectively), we were wondering (1) if this system plays a role in color vision on the perceptual level and (2) if the sluggish behavior of thalamic blue-ON cells is reflected in reaction times to S-cone isolating stimuli. We trained two male cats to perform a simple contrast discrimination task where they had to respond to the appearance of a spot by pressing a glass plate located in front of the stimulus monitor. We rewarded responses given within a limited time window by liquified food. A trial was deemed incorrect when the animal pressed the response key outside the valid time window. The target spot had 50% positive or negative cone-contrast for the ML-, S- or both cones (achromatic) against the grey background and trials without a target were used as control. We measured simple reaction times and percentage of correct trials. Reaction times were not significantly different for the three color conditions (S: 908.54±214.35 ms; ML: 906.01±198.45 ms; ach: 874.63±211.18 ms (mean±SD) , p=0.46, ANOVA), although they were slightly longer for the S- and ML-cone isolating stimuli. However, percentage of correct trials was significantly lower for the S-cone isolating condition than for the achromatic one (56.06±18.26% and 74.38±19.07%, respectively, p=0.015, ANOVA). Performance for the ML-cone isolating stimuli was between that of the other two conditions but did not differ significantly (64.76±13.92%; ML vs S: p=0.17; ML vs Ach: p=0.14). Based upon our results we can conclude that the S-cone-driven pathway plays an important role in the cat color perception but S-cone isolating colors are harder to see.

Acknowledgements: (1) EFOP-3.6.1.-16-2016-00004; (2) Hungarian Brain Research Program (NAP 2.0); (3) Medical School, University of Pecs (KA-2018-12)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you are interested in our research in more detail, feel free to leave comments or questions in the comment zone provided by the organizers or find me directly via email (peter.kobor@aok.pte.hu).

Abstract ID: 1758

Spot illumination within the blind spot affects the absolute threshold for light in a normal region of the visual field.

Poster Presentation - *Topic area: Color, Light and Materials: Models and mechanisms*

Marina Saito[1,3] (marina@l.u-tokyo.ac.jp), Kentaro Miyamoto[2], Ikuya Murakami[1]; [1]Department of Psychology, the University of Tokyo, [2]Department of Experimental Psychology, University of Oxford, [3]Japan Society for Promotion of Science

Spot illumination directly entering the natural blind spot is invisible to us because of the lack of rod/cone photoreceptors there. However, our previous research (Saito et al., 2018) demonstrated that spot illumination projected to the blind spot affects our brightness perception in a normal region of the visual field, suggesting that there exists a mechanism that makes it possible to receive spot illumination within the blind spot. Nevertheless, we still do not understand the relationship between the blind-spot illumination and other performances such as light detection threshold and contrast sensitivity. The present study aimed to test whether the light detection threshold in a normal region of the visual field changes when the blind spot is simultaneously illuminated. Observers viewed stimuli with only the right eye open. We compared the absolute threshold for a light stimulus flashed in the left visual hemifield with and without simultaneous illumination within the blind spot of the right eye. We found that the light detection threshold increased when the blind spot was illuminated by low-luminance blue light ($t(17) = -2.99$, $p < .05$). Next, we determined contrast threshold for a light stimulus within a gray background in the left hemifield with and without simultaneous illumination within the blind spot of the right eye. The contrast threshold did not change when we simultaneously illuminated the blind spot ($t(17) = -1.19$, $p > .05$). Therefore, we suggest that there exists a mechanism receiving illumination within the blind spot and that illumination projected to the blind spot is invisible to us but affects our absolute threshold for light elsewhere. A possible account involves melanopsin photopigment that is reportedly expressed along axons passing through the optic disk.

Acknowledgements: This study is supported by JSPS KAKENHI Grant Number JP 19J23222

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 943

Temporal evolution of colour representation measured with magnetoencephalography (MEG).

Poster Presentation - *Topic area: Color, Light and Materials: Models and mechanisms*

Erin Goddard[1] (erin.goddard@mail.mcgill.ca), Christopher Shooner[1], Kathy T Mullen[1]; [1]McGill University

Colour perception is based on the differential spectral responses of the L,M and S-cones, subsequent subcortical and cortical computations, and may include the influence of higher order factors such as language. Due to our much higher sensitivity to L/M cone opponent contrast than S-cone contrast, a colour space that is ‘perceptually uniform’ is very different to one defined by cone contrast. Here we compare the evolution of different colour representations over time using magnetoencephalography (MEG). We measured neural responses to 14 hues at each of 3 achromatic offsets (increment, equiluminant and decrement). Stimuli were circular blobs (40-deg diameter) of 300ms duration, smoothed in space and time, each presented 42 times in a counterbalanced order. For each subject (n=8), we trained classifiers to discriminate all possible pairs of stimuli using MEG responses at each timepoint (10ms bins). From ~100ms after stimulus-onset, we found robust classification of stimuli varying in hue and/or achromatic offset. For stimuli differing only in achromatic offset, classifier performance peaked at ~160ms after stimulus onset, then decayed. For stimuli that varied only in hue, classifier performance remained high ~160-400ms. This suggests that while early neural responses differentiate stimuli both on chromatic and achromatic content, they then shift towards a more colour-dominated response. Using Representational Similarity Analysis (RSA) we found that models based on colour, including hue and colour category, correlated well with the data at later times (after 400ms). Surprisingly, these models did not perform significantly better than one based on raw cone contrast, even though cone contrast is not a good predictor of perceptual measures such as visibility and discriminability. We conclude that to demonstrate the emergence of neural representations of perceived hue or colour category, it is crucial to demonstrate that these ‘higher-level’ models provide a better account than lower-level stimulus representations, such as cone contrast.

Acknowledgements: This work was funded by Canadian Institutes of Health Research (CIHR) grant 153277 and Natural Sciences and Engineering Research Council (grant RGPIN 183625-05) to KTM

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 820

The effect of chromaticity separation on neural processing during a visual task

Poster Presentation - *Topic area: Color, Light and Materials: Models and mechanisms*

Lisa Lindquist[1] (lisalindquist@nevada.unr.edu), Gregory McIntire[1], Sarah Haigh[1]; [1]University of Nevada, Reno

Our modern environment includes synthetic visual stimuli that frequently deviate from natural scenes, for example, flickering lights and computer screens, striped patterns and extreme color contrasts. Large differences in chromaticity separation (e.g. red and blue) elicit visual discomfort, large metabolic responses, and greater alpha suppression compared to small chromaticity separations (e.g. pink and purple). This suggests that visual cortex over-responds to large color differences. To investigate if uncomfortable chromatic stimuli negatively impact visual task performance, we presented 30 individuals (11 male and 19 female) with grating patterns composed of pairs of colors (either red-blue, blue-green or red-green) that varied in their chromaticity separation (small, mid-small, mid-large, and large; calculated in CIE UCS 1976 space). Gratings were superimposed with black letters, presented in a white circle and situated at the center of the screen. Participants completed a continuous pairs task while electroencephalography (EEG) was recorded. Letters were presented sequentially at 3Hz and the gratings alternated with a grey screen at 5Hz. This allowed for frequency tagging in the steady-state visual evoked potential (SSVEP) to assess responses to incremental differences in chromatic separation (at 5Hz) and their effect on task-related processing (at 3Hz). A subset of participants rated the gratings on a 9-point scale of discomfort. In accordance with prior research, we observed greater ratings of discomfort and increased power at 5Hz with the larger chromaticity separations, but no significant effect on power at 3Hz and no consistent effect on behavioral accuracy. Despite eliciting heightened neural responses, short term exposure to uncomfortable chromatic stimuli does not adversely impact visual task performance.

Acknowledgements: NSF EPSCoR (1632849)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 828

Cortical Organization and Dynamics

“Number form area” distinguishes between numerals and other character categories during passive viewing: A meta-synthesis of representational similarity analyses with three studies

Talk Presentation - *Topic area: Cortical Organization and Dynamics*

Darren Yeo[1,2] (jiansh.yang@gmail.com), Courtney Pollack[3], Rebecca Merkley[4,5], Daniel Ansari[4], Gavin Price[1]; [1]Vanderbilt University, [2]Nanyang Technological University, [3]Boston College, [4]University of Western Ontario, [5]Carleton University

A region in the posterior inferior temporal gyrus (pITG) is thought to be specialized for processing Arabic numerals. fMRI studies that compared passive viewing of numerals to other character types (e.g., letters and novel characters) have not found evidence of numeral preference in the pITG. However, recent studies showed that the engagement of the pITG is modulated by attention and task contexts, suggesting that passive viewing paradigms may be ill-suited for examining numeral specialization in the pITG. It is possible, however, that even if the strengths of responses to different category types are similar, the distributed response patterns (i.e., neural representations) in a candidate, meta-analytic numeral-preferring pITG region (“pITG-numerals”) may reveal categorical distinctions, even during passive viewing. Using representational similarity analyses with three datasets that share the same task paradigm and stimulus sets (Ns = 19, 32, and 37), we tested whether the neural representations of digits, letters, and novel characters in pITG-numerals were organized according to visual form and/or conceptual categories (e.g., familiar versus novel, numbers versus others). Small-scale frequentist and Bayesian meta-analyses of our dataset-specific findings revealed that the organization of neural representations in pITG-numerals is unlikely to be explained by differences in abstract shape (BF_+0 = 0.26), but can be explained by a categorical “digits versus letters” distinction (BF_+0s = 11.5 – 51.2), or even a “digits versus others” distinction (suggesting numeral preference) (BF_+0 = 13.6). These results suggest pITG-numerals is likely part of a neural pathway biased for processing objects with potential numerical relevance, and that this biased processing is evident even during passive viewing. Given that numerals and letters do not differ categorically in terms of shape, categorical distinction in pITG-numerals during passive viewing must reflect ontogenetic differentiation of symbol set representations based on repeated usage of numbers and letters in differing task contexts.

Acknowledgements: NSF (DRL 1660816, DRL 1750213); Brain Canada and NeuroDevNet award; Canada First Research Excellence Fund, NSERC, CIHR, and Canada Research Chairs Program; E.W.R Steacie Memorial Fellowship; HASS International PhD Scholarship: Nanyang Technological University & Ministry of Education (Singapore)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

A PDF of the presentation slides can be downloaded by clicking on the supplement above.
For a copy of the full paper in NeuroImage:
https://www.sciencedirect.com/science/article/pii/S1053811920302032

Besides the chat box above, feel free to contact me via the following if you have any questions or feedback:
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Abstract ID: 733

A unifying framework for understanding neural tuning and representational geometry

Talk Presentation - *Topic area: Cortical Organization and Dynamics*

Nikolaus Kriegeskorte[1,2] (n.kriegeskorte@columbia.edu), Xue-Xin Wei[1]; [1]Zuckerman Mind Brain Behavior Institute, Columbia University, [2]Department of Psychology, Department of Neuroscience, Columbia University

A central goal of visual neuroscience is to understand the representations formed by brain activity patterns and their connection to behavior. The classical approach is to investigate how individual neurons encode the visual stimuli and how their tuning determines the fidelity of the neural representation. Tuning analyses often use the Fisher information to characterize the sensitivity of neural responses to small changes of the stimulus and the mutual information to characterize the information the response conveys about the stimulus. In recent decades, measurements of the activity of large populations of neurons have motivated a complementary approach, which focuses on the information available to linear decoders. A linear decoder projects the representational patterns onto a single dimension. All possible such projections, together, define the representational geometry, i.e., the geometry in multivariate response space of the points that correspond to the stimuli. The relationship between the tuning curves and the representational geometry they give rise to has remained unclear. Here, we clarify this relationship through theoretical analyses and computer simulations. What emerges is a unifying framework, which defines the mathematical relationships between neural tuning, neural noise, representational geometry, Fisher information, mutual information, and perceptual discriminability (Figure 1). We demonstrate several known and some possibly unknown insights: (1) The tuning and the noise co-determine the mutual information and the Fisher information. (2) The tuning and the noise co-determine the geometry. (3) The geometry does not

determine the tuning. (4) The geometry and the noise co-determine the Fisher information and the mutual information. (5) The Fisher information does not determine the geometry. (6) The tuning and the noise co-determine the perceptual sensitivity. (7) The geometry and the noise co-determine the perceptual sensitivity. Our framework can help guide future studies aiming to clarify the connections between stimulus, brain activity, and perception.

This talk will be presented in Live Talk Session 3, Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 235

Computational evidence for integrated rather than specialized feature tuning in category-selective regions

Talk Presentation - *Topic area: Cortical Organization and Dynamics*

Jacob S. Prince[1] (jacob.samuel.prince@gmail.com), Talia Konkle[1]; [1]Harvard University

Along the human ventral visual stream, there are regions of cortex that show strong overall response selectivity for faces (FFA) and places (PPA). A prominent hypothesis is that these regions have distinct feature tuning specialized for their preferred stimulus domains. However, the presence of systematic information about non-preferred stimulus classes in these regions suggests an alternative hypothesis: that category-selective regions may reflect different facets of a larger-scale population code with an integrated feature space. We tested these competing hypotheses using deep neural networks. To operationalize specialized feature spaces, we trained a pair of resource-matched networks: one was trained only on face images to recognize different identities, and the other was trained only on place images to do scene categorization. To operationalize an “integrated” feature space, we trained a network to perform object recognition sampled from many different categories. Within this network, we localized face- and place-selective units in each layer, following the same procedures used when analyzing functional neuroimaging (fMRI) data. We then used representational similarity analyses to evaluate how well these different feature spaces matched human fMRI data in two datasets. Overall, human FFA and PPA representational geometries were better fit by the responses of face and place units defined from the integrated model (best layer FFA: r=0.85, PPA: r=0.74), compared to responses of the specialized models (FFA: r=0.62, PPA:

r=0.47). More strikingly, variance partitioning analyses revealed that nearly all explainable, non-shared variance was accounted for by the integrated model. These patterns held across model layers, were robust across different base model architectures, and did not emerge in untrained networks. Together, these converging results suggest that representations in category-selective regions may be better understood as facets of a common feature bank that can discriminate among many classes of objects, rather than as distinct modules with specialized, unrelated feature tuning.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Thanks for coming to our talk! Please feel free to reach out with any questions or feedback by emailing me at jacob.samuel.prince@gmail.com

To view this talk with captions, please visit the following YouTube link: https://www.youtube.com/watch?v=y5g36vMNz_0&feature=youtu.be

Abstract ID: 1577

Measuring contrast sensitivity functions in human visual cortex

Talk Presentation - *Topic area: Cortical Organization and Dynamics*

Carlien Roelofzen[1,2] (c.roelofzen@spinozacentre.nl), Jelle A. Van Dijk[1], Maartje C. De Jong[1,3], Serge O. Dumoulin[1,2,4]; [1]Spinoza Centre for Neuroimaging, Royal Netherlands Academy of Sciences, Amsterdam, [2]VU University Amsterdam, [3]University of Amsterdam, [4]Utrecht University

The contrast sensitivity function (CSF) is widely used in visual perception research and to characterize visual disorders. The CSF defines the lowest contrast level that participants can detect as a function of spatial frequency. Here, we translated this psychophysical model to a neural model by presenting a new method that estimates the CSF in the human visual cortex using ultra-high field (7 Tesla) functional magnetic resonance imaging (fMRI). During the fMRI experiment, we presented a full-field stimulus consisting of different gratings that vary systematically in contrast and spatial frequency. We modeled the CSF using an exponential function, whose parameters include maximum contrast sensitivity and its corresponding spatial frequency and width of the left side and right side of the CSF (Chung & Legge, 2015). Next, we predicted the fMRI response by a multiplication of the CSF model with the stimulus sequence and convolved this model time course with the hemodynamic response function (method analogous to the population

receptive field method by Dumoulin & Wandell, 2008). We show that the CSF model explains a significant amount of the variance in the fMRI time series. Moreover, the properties of the CSF model differ between locations in the visual cortex. For example, the preferred maximum spatial frequency and maximum contrast sensitivity are highest for voxels in the foveal region and decrease as a function of eccentricity. These results are similar across visual field maps V1, V2, and V3. Thus, the cortical CSFs vary systematically across eccentricity. This method can be applied to clinical conditions where a reduction in the CSF is present, e.g. amblyopia, glaucoma or macular degeneration. In these cases, the presented method can provide novel insights into the neural processes underlying the perceptual abnormalities.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1379

Opposed transcriptomic gradients contribute to both the arealization of human visual cortex and the topological layout of its orthogonal maps

Talk Presentation - *Topic area: Cortical Organization and Dynamics*

Jesse Gomez[1,2], Zonglei Zhen[3], Kevin S. Weiner[2]; [1]Princeton University, [2]University of California Berkeley, [3]Beijing Normal University

While recent findings demonstrate an unexpected coupling between functional and cytoarchitectonic regions relative to the folding of human visual cortex, a unifying principle linking these anatomical and functional features of cortex remains elusive. To fill this gap in knowledge, we summarize findings from two of our recent studies that examined two main questions: 1) Does differential gene expression among cytoarchitectonic areas contribute to the arealization of occipito-temporal cortex into a processing hierarchy? 2) Does differential gene expression also contribute to the topological layout of orthogonal functional maps within visual areas? Our multimodal approach revealed two main findings. First, there are two large-scale opposing gene expression gradients in human occipito-temporal cortex: one that contains a series of genes with expression magnitudes that ascend from posterior (e.g. areas hOc1, hOc2, etc.) to anterior cytoarchitectonic areas (e.g. areas FG1-FG4) and another that contains a separate series of genes that show a descending gradient from posterior to anterior areas. Using data from the living human brain, we show that each of these gradients correlates strongly with variations in measures related to either

thickness or myelination of cortex, respectively. Second, additional transcription gradients exist within single visual field maps that capture the orthogonal functional maps of receptive field eccentricity and polar angle. The genes contributing to the fine-scale layout of maps within areas are largely distinct from those contributing to the large-scale expression gradients contributing to the arealization of human visual cortex. The combination of these findings suggest a new rule of cortical organization in which the adult brain employs opposed transcriptional gradients at multiple spatial scales. Altogether, these findings help pinpoint the genes contributing to healthy cortical development, as well as establish essential groundwork for understanding future work linking genetic mutations with the function and development of human visual cortex.

Acknowledgements: This work was supported by (1) start-up funds provided by the University of California, Berkeley and the Helen Wills Neuroscience Institute (KSW), (2) Ruth L. Kirschstein National Research Service Award F31EY027201 (JG), and (3) the National Natural Science Foundation of China 31771251 (ZZ).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 343

Spontaneous brain oscillations and visual perceptual decision making

Talk Presentation - *Topic area: Cortical Organization and Dynamics*

Jason Samaha[1], Luca Iemi[2], Saskia Haegens[2,3], Niko Busch[4]; [1]University of California, Santa Cruz, [2]Columbia University College of Physicians and Surgeons, [3]Donders Institute for Brain, Cognition and Behaviour, [4]University of Münster

Perceptual decisions arise from visual input interacting with ongoing brain activity, yet the specific contribution of spontaneous brain activity to visual perceptual decision making has not been established. Here, we review two decades of work looking at how trial-to-trial variability in the amplitude of brain oscillations impacts subjective and objective aspects of visual perception. Surprisingly, computational models of perceptual decision making have only recently been applied in this context, providing an opportunity to unify decades of data into a common decision-making framework. A synthesis of this data along with new experiments from our lab reveals several novel conclusions: 1) Trial-to-trial fluctuations in the power of prestimulus alpha (~ 10 Hz) oscillations consistently modulate perceptual decisions of the same physical stimulus 2) The mechanisms by which this happens are sensory in nature, as reduced alpha leads to enhanced early visual responses 3) In detection tasks, lower prestimulus alpha power increases

both hit rates and false alarm rates equally, leading to no change in sensitivity (d'). 4) In discrimination tasks lower prestimulus alpha power does not change accuracy but, 5) enhances subjective reports of confidence and visibility. We propose a detection theoretic model that can qualitatively capture all of these empirical results. The model assumes that prestimulus alpha equally impacts the distributions of sensory evidence as well as noise and that criteria for detection and confidence/visibility do not update to accommodate sensory changes. The implication of this is that subjective aspects of perception (visibility, detection, confidence) readily dissociate from objective discrimination performance (d') because our subjective estimates do not adapt to moment-to-moment changes in alpha-related fluctuations in cortical excitability.

This talk will be presented in Live Talk Session 4, Monday, 22 June, 4:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1729

Visual topographic organization in human hippocampus revealed by connective field modelling during naturalistic vision and resting state.

Talk Presentation - *Topic area: Cortical Organization and Dynamics*

Tomas Knapen[1] (tknapen@gmail.com); [1]VU Amsterdam, the Netherlands, [2]Spinoza Centre, KNAW, Amsterdam, the Netherlands

The hippocampus integrates over timescales, modalities, and events to generate abstract representations for memory-guided behaviour. But for our memories to guide perception and action, the hippocampus must map its abstractions back into the concrete sensory topographies that are 'in touch' with the outside world. Here, I identify topographic hippocampus-visual connectivity by means of connective field mapping. Specifically, this method models fMRI timecourses as originating from distinct topographic locations in V1. If topographic V1-hippocampus connectivity plays a functional role in our understanding of the visual world, one would expect to find this topographic connectivity in naturalistic vision. This connectivity, then, should be even stronger in the resting state when activations are dominated by top-down influences. Using the 7T HCP retinotopy, movie, and resting state fMRI datasets (totalling 2.5 hours for 181 subjects each), I show that there is topographic connectivity between hippocampus and V1 during movie watching, covering the entire visual field. This connectivity is localised to hippocampal output subregions. The spatial pattern

of connectivity is stable: a voxel's topographic connectivity pattern during movie watching predicts the selfsame spatial pattern in the resting state. Moreover, the strength of V1-hippocampus topographic connectivity is stronger in resting state vs movie watching, indicative of enhanced top-down processing. Conversely, an opposite relation holds for topographic connectivity between V1 and thalamus, colliculus and cerebellum, indicating that for these regions connectivity is dominated by bottom-up and oculomotor processing. These findings show that the hippocampus connects topographically to visual cortex, bridging recent animal studies into visual-hippocampal connectivity and human imaging. The uncovered visual-hippocampal connections are likely to play an essential role in both naturalistic vision and mind-wandering.

Acknowledgements: NWO-CAS collaboration grant & ABMP

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 2:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

You can follow me on twitter: @Tknapen
This video is also available on YouTube: https://youtu.be/vnsHw4E32b0 where you can leave comments. A preprint of this work will come online soon.

Abstract ID: 984

Development

Age-related changes in perceptual decision-making in children

Talk Presentation - *Topic area: Development*

Catherine Manning[1] (catherine.manning@psy.ox.ac.uk), Udo Boehm[2], Gaia Scerif[1], Anthony M Norcia[3], Eric-Jan Wagenmakers[2]; [1]University of Oxford, [2]University of Amsterdam, [3]Stanford University

Children make better decisions about perceptual information as they get older, but it is unclear how different aspects of the decision-making process change with age. The drift diffusion framework offers the possibility to model accuracy and response-time distributions to decompose performance into separate processing components that can then be linked to neural measures. Within this framework, the decision-making process is modelled as an accumulation of noisy sensory information towards one of two decision bounds. The main parameters are drift-rate (reflecting the rate of evidence accumulation), boundary separation (reflecting response caution), and non-decision time (reflecting sensory encoding and response generation). Here, we collected behavioural and EEG data from 96 children aged 6 to 12 years and 20 adults performing a coherent motion discrimination task. We fitted hierarchical Bayesian drift diffusion models to the behavioural data from each group, allowing drift-rate to vary across the 3 coherence conditions (30%, 50%, 75%), while keeping all other parameters constant across conditions. Older children and adults had higher drift-rates, narrower boundary separations, and shorter non-decision times than younger children. Next, we used Reliable Components Analysis to identify a response-locked EEG component in children and adults that was maximal over centro-parietal electrodes and showed a ramping positivity preceding the response. The rising positivity was steeper in adults than in children. We derived the slope of this activity for each participant and entered it as a regressor in the model. We found that this EEG activity was related to drift-rate in both groups. Our results suggest that age-related improvements in children's perceptual responses are accompanied by age-related differences in both decisional and non-decisional factors. Furthermore, we report a neural correlate of the decision-making process. These results help to bridge brain and behaviour in understanding the development of perceptual decision-making in children.

Acknowledgements: This project was funded by an Experimental Psychology Society small grant, a Scott Family Junior Research Fellowship at University College, Oxford, and a Sir Henry Wellcome Postdoctoral Fellowship awarded to CM, and a James S. McDonnell Foundation Understanding Human Cognition Scholar Award to GS.

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 109

Biological action identification does not require early visual input for development

Talk Presentation - *Topic area: Development*

Siddhart Srivatsav Rajendran[1,2] (sidopto@gmail.com), Davide Bottari[3], Idris Shareef[1,2], Kabilan Pitchaimuthu[1], Suddha Sourav[1], Nikolaus Troje[4], Ramesh Kekunnaya[2], Brigitte Röder[1]; [1]University of

Hamburg, Hamburg, Germany, [2]LV Prasad Eye Institute, Hyderbad, India, [3]IMT School for Advanced Studies, Lucca, Italy, [4]Center for Vision Research, York University, Toronto, Canada

Visual input during developmental years is vital for the maturity of numerous visual functions. Previous reports have shown that, while normal development of global motion perception seems to require visual input during an early sensitive period, biological motion detection does not seem to do so. A more complex form of biological motion processing is the identification of human actions. Here we tested whether the identification rather than detection of biological motion is experience dependent. A group of human participants who had been treated for partially long lasting congenital cataract (up to 14 years, CC group) had to identify ten actions performed by human line figures. In addition they performed a coherent motion detection task (CM task), which required to identify the direction of coherent motion amidst the movement of random dots. As controls, individuals with developmental cataracts were included to control for the timing of the visual deprivation. Moreover, normally sighted controls were tested both with vision blurred to match the visual acuity of the CC individuals (vision matched group) and with full sight (sighted controls group). The CC group identified biological actions with an extraordinary high accuracy (~85%) and was indistinguishable from the vision matched group. By contrast, coherent motion processing impairments of the CC group persisted even after controlling for visual acuity. These results in the same individuals demonstrate an impressive resilience of biological motion processing to aberrant early visual experience and at the same time a sensitive period for the development of global motion processing in early ontogeny.

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1781

Dramatic Changes in Mechanisms of Task-Irrelevant Visual Perceptual Learning from Childhood to Adulthood

Talk Presentation - *Topic area: Development*

Sebastian M. Frank[1,2], Susanne Bründl[2], Ulrike I. Frank[2], Yuka Sasaki[1], Mark W. Greenlee[2], Takeo Watanabe[1]; [1]Brown University, [2]University of Regensburg

Visual perceptual learning (VPL) is a powerful tool to investigate how learning and its underlying mechanisms develop over the lifespan. Previous results with adults suggest that task-irrelevant VPL occurs only for stimuli below the perceptual threshold, because such stimuli remain undetected by attentional control and are not inhibited as task-irrelevant (Watanabe et al., 2001; Tsushima, Sasaki & Watanabe, 2006). Since attention control systems continue to develop from childhood until adulthood, children might show different task-irrelevant VPL compared with adults. To investigate this hypothesis, we examined task-irrelevant VPL in a group of elementary school children (7-10 years old, n = 20) and an adult control group (18-31 years old, n = 20). Over the course of twelve daily sessions, subjects performed a rapid-serial-visual-presentation task at the screen center, while coherent motion was presented as a task-irrelevant stimulus in the surrounding. The motion coherence level was either below or above the detection threshold. Before and after training, discrimination performance for the exposed coherent motion direction was tested. The results show that adults only improved on the direction exposed below coherence threshold as previously reported, whereas children showed improved discrimination performance irrespective of the motion coherence level during the exposure. The occurrence of task-irrelevant VPL with the above-threshold motion in children was not due to the weaker inhibition on task-irrelevant motion, because children with more pronounced selective attention ability shown by the Useful-Field-of-View test (Ball et al., 1988) tended to have greater amounts of task-irrelevant VPL. These results suggest that the mechanism of task-irrelevant VPL in children is dramatically different from that found in adults. Children may have an expanded focus of attention, allowing task-irrelevant VPL of the suprathreshold coherent motion direction together with the RSVP. Thus, the interaction between attentional control and VPL undergoes a developmental maturation from childhood to adulthood.

Acknowledgements: NIH R01EY019466, NIH R21EY028329, NIH R01EY027841, BSF2016058

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please send an email to sebastian_frank@brown.edu for further contact.

Abstract ID: 141

Face selectivity in human infant ventral temporal cortex.

Talk Presentation - *Topic area: Development*

Heather L. Kosakowski[1] (hlk@mit.edu), MIchael Cohen[1,2], Boris Keil[3], Atsushi Takahashi[1], Isabel Nichoson[4], Lyneé Alves[5], Nancy Kanwisher[1], Rebecca Saxe[1]; [1]MIT, [2]Amherst College, [3]Mittelhessen University of Applied Science, [4]Wellesley College, [5]University of Denver

The adult human ventral temporal cortex (VTC) contains regions with strong category selective responses. When and how do these arise in development? fMRI studies in awake human and macaque infants (Deen et al., 2017; Livingstone et al., 2017) found adult-like regions with reliable preferences for faces>scenes or scenes>faces that lacked full category selectivity (i.e., these regions did not show faces>objects or scenes>objects). In Experiment 1, we replicated these results with a new group of awake infants (n=16; 2.5-8.7 months) using the same infant coil and quiet pulse sequence. Infants watched videos of faces, objects, bodies, and scenes. High head-motion data were excluded as in Deen et al (2017). Voxels were selected for each contrast in each infant using a subset of the data, and response magnitudes in those voxels were quantified in held-out data (see Figures 1 and 2); these response magnitudes were then compared across subjects in a paired t-test for each region and contrast. We replicated previous findings that infants have reliable face>scene and scene>face responses in VTC that are not fully category selective (i.e., these regions do not respond more to faces> objects and scenes>objects respectively). In a second experiment (n=8; 4.6-9.3 months), we optimized infant data acquisition with a variety of technical innovations: 1) an infant coil that increases the signal-to-noise ratio by 25%, 2) novel MR-safe headphones, and 3) an improved pulse sequence. The analysis pipeline was identical for both experiments. This experiment replicated face and scene preferences and the lack of selectivity for scenes>objects. Crucially, however, we found regions in infant VTC that responded significantly more to faces than to scenes, bodies, and objects. These data suggest that fMRI noise was a major limitation in previous infant fMRI experiments and show the first fMRI evidence for truly face-selective cortical regions in human infants.

Acknowledgements: GRFP, NSF to HLK; CBMM; NIH Grant DP1HD091947 to N.K.

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

A recorded version of this talk with subtitles on YouTube: https://youtu.be/gHUq3Qh-z2g

Abstract ID: 790

Top-down modulation of visual cortex in the developing human brain

Talk Presentation - *Topic area: Development*

Yaelan Jung[1], Tess Allegra Forest[1], Dirk B. Walther[1,2], Amy S. Finn[1]; [1]University of Toronto, [2]Samsung Artificial Intelligence Center Toronto

Do neural representations in the visual cortex change from childhood to adulthood? Unlike associative cortex, the structure and functional organization of visual cortex is thought to mature relatively early in life. However, it is unknown whether the representation of information in visual cortex changes with development. Given ongoing development of association cortex—prefrontal and parietal regions in particular—it is possible that children's visual cortex might be less modulated by the top-down signals coming from these regions. If so, it is possible that children's visual cortex represents more task-irrelevant information as compared with adult visual cortex. In the present study, we ask how top-down signals modulate neural representations in children's visual cortex. We measured brain activity using fMRI while adults (21-31 years) and children (7-10 years) were performing a one-back working memory task in which they were directed to attend to either motion or an object present in a complex display where both objects and motion were present. To examine how these features are represented in children's and adults' visual cortices, we used multivoxel pattern analysis and compared decoding accuracy of task-relevant and task-irrelevant features. In adults' visual cortex, we found higher decoding accuracy for task-relevant features (i.e. motion direction in the motion-attended condition) compared to those for task-irrelevant features (i.e. objects in the motion-attended condition). However, in children's visual cortex, both task-relevant and task-irrelevant features were decoded equally well. These findings show that the developing visual cortex might represent more information than the adult visual cortex, which is known to prioritize task-related information. Also, this research suggests that unlike the structural properties, the functional properties of visual cortex continue to develop into late childhood.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

In this study, we explore how top-down modulation impacts neural representation in the visual cortex in children!

If you have any questions or comments about our work, please feel free to reach out to me:
email: yaelanj@princeton.edu
twitter: @yaelanjung

Thank you!

Abstract ID: 597

Visual attention in the first two years of life differentially predicts language abilities in children with and without autism spectrum disorder

Talk Presentation - *Topic area: Development*

Sanju Koirala[1,2], Deniz Parmaksiz[1,2], Stella(Yixin) Yuan[1,2], Sarah Shultz[1,2], Ami Klin[1,2], Warren Jones[1,2], Laura A. Edwards[1,2]; [1]Marcus Autism Center, [2]Emory University

Infants' patterns of visual attention to faces change over the first two years of life. Typically developing (TD) infants tend to shift their attention from a speaker's eyes to mouth, and this attentional shift has been shown to predict language outcomes. In contrast, infants later diagnosed with autism spectrum disorder (ASD) show atypical patterns of visual attention to faces, such as persistently reduced attention to a speaker's eyes. However, the relationship between these visual fixation patterns and later language abilities is not well understood. This study examines the critical role of early visual attention in the acquisition and employment of functional language in a longitudinal cohort of infants at high and low familial risk for ASD. Eye-tracking measures of visual attention were collected and quantified as the percentage of time spent visually fixated on regions-of-interest (ROIs) defined as eyes, mouth, body, and object. At 24 months, language development was measured using the Mullen scales of early learning, and clinical best estimates confirmed diagnoses of ASD. Within-group Pearson correlations revealed that TD infants' eye-looking at the beginning of the first year of life (n=93, Mage=5.14mo) positively predicted receptive language (r=0.312, p=0.002), and mouth-looking during the second year of life (n=80, Mage=15.21mo) trended towards positive prediction of expressive language scores. Increased visual attention to eyes at the beginning of the first year of life is therefore adaptive in TD infants. In infants later diagnosed with ASD, patterns of visual fixation were unrelated to language scores. Instead, ASD infants' early eye-looking (n=40, Mage=5.12mo) and later (n=45, Mage=15.23mo) object-looking predicted ASD severity at 24 months (r=-0.346, p=0.029, r=0.384, p=0.009 respectively). Further analyses will investigate longitudinal trajectories of visual attention as predictors of language outcome in both ASD and TD infants.

Acknowledgements: NIMH P50 MH100029, The Marcus Foundation, The Whitehead Foundation, The Georgia Research Alliance, and NICHD K99 HD097290

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for your time. If you have any further questions/suggestions or want to connect, feel free to reach out at
Email: sanju.koirala@emory.edu
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Abstract ID: 1625

Young children outperform feed-forward and recurrent neural networks on challenging object recognition tasks

Talk Presentation - *Topic area: Development*

Vladislav Ayzenberg[1] (vayzenb@emory.edu), Stella Lourenco[1]; [1]Emory University

Unlike artificial neural networks (ANNs), human object recognition is robust in degraded conditions. Accumulating evidence suggests that recurrent connections within the ventral visual stream are necessary in such conditions. Indeed, incorporating recurrence within ANNs significantly improves their performance. Nevertheless, despite the success of recurrent ANNs over purely feedforward ones, the recognition abilities of these models on degraded objects lags far behind that of human adults. Why is the human visual system impervious to such conditions? In a novel approach to answering this question, we compared the recognition abilities of state-of-the-art ANNs to 4- and 5-year-old children. Although children show impressive object recognition abilities, it remains unknown how robust these abilities are when objects are degraded or under speeded conditions. Children (N = 84) were tested on a challenging object recognition task which required them to identify rapidly presented object outlines (100 ms - 300 ms; forward and backward masked) that had perturbed or illusory contours. We found that even the youngest children successfully identified both perturbed and illusory outlines at the fastest speeds, even though objects were both forward and backward masked. By contrast, neither a feedforward model (VGG19), nor a model that approximates recurrence (ResNet101), showed comparable performance to children. Thus, despite receiving exponentially more supervised object training than children (Zador, 2019), ANNs fall short of the recognition abilities of children. We suggest that, from early in development, robust object recognition in humans may be supported by parallel feedforward processes in the dorsal stream, in addition to recurrent processes in ventral stream.

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 310

Development: Atypical, aging

Aging and the perception of motion-defined form

Poster Presentation - *Topic area: Development: Atypical, aging*

J. Farley Norman[1] (farley.norman@wku.edu), Karli Sanders[1], Hannah Shapiro[1], Ashley Peterson[1]; [1]Western Kentucky University

A single experiment required 26 younger and older adults to discriminate global shape as defined only by differences in the speed of stimulus element rotation (cf, Julesz & Hesse, 1970). Detection of the target shape required successful perceptual grouping by common fate. A considerable adverse effect of age was found. In order to perceive the target and discriminate its shape with a d' value of 1.5, the older observers needed target element rotational speeds that were 23.4 percent faster than those required for younger adults. In addition, as the difference between the rotation speeds of the background and target stimulus elements increased, the performance of the older observers improved at a rate that was only about half of that exhibited by the younger observers (this age-related difference in rate of improvement was significant, $t(24) = 2.70$, $p = .013$, 2-tailed). The overall results indicate that while older adults can perceive global shape defined by similarity (and differences) in rotational speed, their abilities are nevertheless significantly compromised.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 137

Altered functional connectivity between the basal nucleus of Meynert and the occipital cortex in congenital blindness

Poster Presentation - *Topic area: Development: Atypical, aging*

Ji Won Bang[1] (jiwon.bang@nyulangone.org), Matthew Murphy[2,3], Joel Schuman[1], Amy Nau[2,4], Kevin Chan[1]; [1]New York University School of Medicine, [2]University of Pittsburgh, [3]Mayo Clinic, [4]Korb and Associates

Congenital blindness can lead to functional and neurochemical alterations in the occipital cortex. However, how such changes are coordinated and modulated between brain regions remain unclear. The basal nucleus of Meynert (BNM) is a group of neurons located mainly in the basal forebrain, and is a major source of cholinergic innervation to the cerebral cortex including the occipital cortex. While changes in cholinergic, glutamatergic and GABAergic metabolisms in the brain have been suggested in the absence of visual experience (Fine & Park, Annu. Rev. Vis. Sci. 2018), no studies have yet examined whether the functional connectivity of BNM is altered in congenital blindness. Here, we recruited 7 congenitally blind (age = 55.43 ± 5.18 years old) and 13 age-matched sighted subjects and obtained their resting-state functional MRI data with eyes closed using a 3 Tesla MRI scanner. We conducted a seed-to-voxel analysis using BNM as a seed and all voxels within the brain as targets. Our results showed that the functional connectivity between BNM and clusters in the occipital cortex of the right hemisphere is enhanced in the congenitally blind subjects (PFDR=0.01). Other brain areas did not show alterations in the functional connectivity to the seed BNM region between blind and sighted subjects (PFDR>0.05). Taken together, the current study shows that the BNM develops stronger functional connectivity to the occipital cortex under the condition of congenital blindness. This finding suggests that the strengthened projections of BNM to the occipital cortex may, at least in part, play a role in the coordination of the occipital cortex of blind people. Future studies may reveal whether the projections of BNM to the occipital cortex drives neurochemical alterations in the occipital cortex of blind individuals.

Acknowledgements: This work was supported by the National Institutes of Health R01-EY028125, T32-EY017271-06; United States Department of Defense DM090217; Alcon Research Institute Young Investigator Grant; and an Unrestricted Grant from Research to Prevent Blindness to NYU Langone Health Department of Ophthalmology

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 380

Behavioural and electrophysiological measures of visual processing for early detection of Alzheimer’s disease

Poster Presentation - *Topic area: Development: Atypical, aging*

Ali Hashemi[1] (hashea@mcmaster.ca), Eugenie Roudaia[1], Nicole D. Anderson[1,2], Claude Alain[1,2], Rosanne Aleong[1], Nasreen Khatri[1], Morris Freedman[1,2], Allison B. Sekuler[1,2,3]; [1]Rotman Research Institute, Baycrest Health Sciences, [2]University of Toronto, [3]McMaster University

Alzheimer's disease (AD) begins years before clinical diagnosis, but there are no simple, cost-effective methods to identify individuals in preclinical stages of AD, when interventions are most likely to succeed. Individuals with AD show deficits in multiple visual functions thought to reflect changes in parieto-occipital and temporal brain regions. However, we know little about how vision changes during preclinical AD – a critical step in determining whether visual tasks can predict AD. Here, we present psychophysical and electrophysiological results for two simplified tasks collected from individuals with mild cognitive impairment (MCI; N=8; Age=61-88, MoCA=20-26) and normal cognition (NC; N=8; Age=62-82, MoCA=23-30). Methods: Face Identification: participants selected which of two briefly presented faces matched a target face identity, measuring accuracy and response time. Contour Integration: we measured density thresholds to identify the global orientation of a spiral contour embedded in a field of cluttering elements. In both tasks, event-related potentials (ERPs) were acquired using the consumer-focused Muse system. Results: Face Identification: the MCI group showed slightly, but not significantly, worse accuracy (Mdiff=0.06, 95%CI=[-0.06,0.19]) and slower response times (Mdiff=-0.35, 95%CI=[-0.96,0.26]) than the NC group. MCI N170s were reduced in amplitude (Mdiff=-1.42μV, 95%CI=[-3.96,1.12]) and delayed (Mdiff=-15.1ms, 95%CI=[-33.8,3.56]) relative to NCs, although these differences also were not significant. Contour Integration: In contrast to the results from face identification, there was a large group difference in both density thresholds (Mdiff=0.45, 95%CI=[0.24,3.56]) and N1 latency (Mdiff=-40.5ms, 95%CI=[-67.7,-13.4]), but not in N1 amplitude (Mdiff=-0.29μV, 95%CI=[-2.84, 2.27]). Delayed N1s were significantly correlated with worse density thresholds (r=-0.78) and lower MoCA scores (r=-0.62), and lower MoCA scores correlated with worse density thresholds (r=0.69). These are the first results showing that behavioural and ERP measures of contour perception may distinguish between normal cognition and MCI. Thus, simple visual tasks may provide viable candidates for early markers of preclinical AD.

Acknowledgements: Centre for Aging and Brain Health Innovation

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

For more information, please join one of our virtual sessions and/or contact myself (ahashemi@research.baycrest.org, twitter @hashemiali) or Eugenie Roudaia (eroudaia@research.baycrest.org, twitter @eyebraineugenie).

Abstract ID: 1624

Central and peripheral motion perception under mesopic conditions in older adults

Poster Presentation - *Topic area: Development: Atypical, aging*

Juan A. Sepulveda[1] (jsep@student.unimelb.edu.au), Andrew J. Anderson[1], Joanne M. Wood[2], Allison M. McKendrick[1]; [1]Department of Optometry and Vision Sciences, The University of Melbourne, Parkville, Victoria, Australia, [2]School of Optometry and Vision Science, Queensland University of Technology, Brisbane, Queensland, Australia

This study aimed to determine how healthy ageing affects motion perception under mesopic relative to photopic light levels in both central and peripheral vision. We compared the performance of 18 younger (20-31 years, mean: 25 years) and 18 older (60-79 years, mean: 70 years) visually normal adults on four motion tasks administered in a random order: grating contrast required to discriminate motion direction, translational global motion coherence, surround suppression of motion, and biological motion detection in noise. Testing was performed binocularly at 0 and 15 degrees of eccentricity. Mesopic conditions were achieved using neutral density filters and 15 minutes dark adaptation. The maximum luminance for the photopic and mesopic conditions were 200 cd/m2 and 0.54 cd/m2 respectively. Conditions were compared using a mixed ANOVA (factors: age group, eccentricity, and lighting). Mesopic conditions elevated contrast thresholds for motion direction discrimination for both groups ($F(1,34)=103.79$, $p<0.001$), particularly in central vision ($F(1,34)= 15.93$, $p<0.001$) and more so for younger adults ($F(1,34)=12.94$, $p=0.001$). Global motion coherence thresholds were elevated under mesopic conditions ($F(1,34)= 11.07$, $p=0.002$), particularly for older adults in peripheral vision (interaction between group, lighting and location: $F(1,34)= 5.15$, $p=0.03$). Older adults showed increased surround suppression of motion peripherally ($F(1,34)=7.18$, $p=0.01$) for both light conditions. Both groups showed poorer ability to discriminate biological motion from noise in mesopic conditions at both eccentricities ($F(1,33)= 6.57$, $p= 0.015$). Overall, changing from photopic to mesopic conditions impacted most motion perception tasks similarly for younger and older adults. A notable exception was global motion coherence thresholds, where under mesopic vision the deterioration in performance centrally was evident in both groups, whereas peripherally older adults demonstrated poorer performance relative to younger adults.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 876

Mapping the binocular scotoma in macular degeneration

Poster Presentation - *Topic area: Development: Atypical, aging*

Cécile Vullings[1] (cecile.vullings@gmail.com), Preeti Verghese[1]; [1]Smith-Kettlewell Eye Research Institute

Macular degeneration (MD) affects the central portion of the retina, resulting in a scotoma. When the scotoma is binocular, it can obscure objects of interest. Furthermore, individuals with MD are often unaware of the scotoma location and of the information they are missing, causing further difficulties in tasks of daily living. As scotoma maps are typically monocular, we address the challenge of precisely mapping the binocular scotoma using an eye-tracker. Nine individuals with MD (six with binocular scotomas) and 3 age-matched controls participated in our study. We measured the extent of the monocular scotoma in each eye using a Scanning Laser Ophthalmoscope/Optical Coherence Tomography (SLO/OCT). Previously, Ghahghaei and Walker (2016) proposed a way to estimate the binocular scotoma by aligning the individual monocular maps on the foveae. We determined whether this algorithm approximates the true scotoma measured under binocular viewing, while eye position was monitored with an eye-tracker. Participants fixated a cross and responded whenever they detected a briefly flashed dot. The dots were first presented on a coarse grid, and then at manually selected points to refine the shape and edges of the scotoma. The monocular scotoma measured in the SLO and eye-tracker are identical, suggesting that individuals use the same preferred retinal locus under both imaging conditions. Moreover, all participants used clustered fixation loci corresponding to their preferred fixation locus. Critically, the binocular scotoma maps from the eye-tracker were highly similar to those obtained with the Ghahghaei-Walker algorithm, yielding an effective method to assess residual retinal function in binocular vision. Determining the size and location of the binocular scotoma with respect to the fixation locus is key to effective training of oculomotor strategies in MD. Our eye-tracker method offers a reliable and sensitive tool for measuring both monocular and binocular scotomata, without the need of an SLO/OCT.

Acknowledgements: This work was supported by a Fulbright grant (C.V.) and a NIH grant NIH R01 EY029730 (P.V.). We would like to thank Dr. Saeideh Ghahghaei for providing the script of the algorithm from Ghahghaei & Walker (2016) and Dr. Don Fletcher for referring the patients who participated in this study.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 819

Stable visual discrimination behaviors in hemispherectomy patients

Poster Presentation - *Topic area: Development: Atypical, aging*

Michael C. Granovetter[1,2] (granovetter@cmu.edu), Leah Ettensohn[1], Marlene Behrmann[1]; [1]Carnegie Mellon University, [2]University of Pittsburgh

Patients with pharmacoresistant epilepsy can undergo cortical resection to remove epileptogenic tissue and alleviate seizures. In extreme cases, a hemispherectomy can be performed, in which an entire cerebral hemisphere is resected or disconnected. Notably, if the procedure is performed before adulthood, overall cognitive functioning may remain intact. However, there has been no systematic investigation profiling visuoperceptual abilities of this patient population. In this study, 16 patients (6- to 34 years-old) with either a left or right hemispherectomy performed a task in which two consecutive stimuli (words in one condition, faces in another) were presented at central fixation. Participants reported, with a keypress, whether stimulus pairs were identical or different. 55 age- and gender-matched controls also performed the task, but with stimuli presented in the left or right visual fields to restrict immediate stimulus processing to a single hemisphere. Crawford & Howell statistical tests for single-subject neuropsychology cases revealed that, remarkably, 13 of the 16 patients exhibited comparable accuracy on both word and face discrimination compared to controls viewing stimuli in either the left or right visual fields (one such patient actually showed superior accuracy for face discrimination). Linear mixed effects modeling showed no main effect of group (patient versus control) or group by stimulus category (words versus faces) interaction among either left or right hemispherectomy patients. Left hemispherectomy patients did demonstrate significantly longer reaction times for word discrimination than for face discrimination, a difference not observed among controls. That said, comparable accuracies of hemispherectomy patients and controls suggest that development of a single hemisphere might be sufficient for word and face processing, thought to be the product of the left and right hemisphere, respectively, in typical controls. Future work will examine hemispherectomy patients' performance on other tasks thought to reflect hemispheric lateralization, such as global/local precedence and spatial frequency processing.

Acknowledgements: The project described was supported by Award Numbers T32GM081760 from NIGMS and R01EY027018 from NEI. The content is solely the responsibility of the authors and does not necessarily represent the official views of NIGMS, NEI, or the NIH.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1188

Visual cortical GABA and depth of amblyopia are negatively correlated

Poster Presentation - *Topic area: Development: Atypical, aging*

Kelly Byrne[1] (knhbyrne@berkeley.edu), Arjun Mukerji[1], Eunice Yang[1], Dennis Levi[1], Michael Silver[1]; [1]UC Berkeley

Amblyopia is a neurodevelopmental disorder that is characterized by reduced visual acuity, atypical binocular integration, and heightened perceptual suppression. Physiology studies in animal models suggest that intracortical GABAergic inhibition might play an important role in mediating amblyopic visual deficits. Magnetic resonance spectroscopy (MRS) and fMRI findings in normally sighted persons (NSP) have demonstrated a negative correlation between occipital GABA concentration and visually evoked fMRI response amplitude. To better understand the relationships among occipital GABA, fMRI responses to visual stimulation, and perceptual suppression in human amblyopia and normal vision, we collected MRS, fMRI, and psychophysical data from both persons with amblyopia (PWA) and NSP. MR spectra that were optimized for GABA measurements were obtained from a voxel positioned bilaterally along the calcarine sulcus, and fMRI responses to checkerboard stimuli were recorded in retinotopically-defined early visual cortical areas. In PWA, we found a robust negative correlation between the depth of amblyopia (interocular difference in visual acuity) and occipital GABA concentration. This relationship was specific to visual cortex and was not observed in a sensorimotor cortical control region. Finally, our data in NSP were consistent with the negative relationship between occipital GABA and fMRI visual cortical response amplitude that has been reported in other studies. However, in PWA, the same relationship between occipital GABA and fMRI response amplitude was absent, or possibly reversed. Taken together, our findings provide evidence that intracortical GABAergic inhibition is a component of the pathology of human amblyopia. We speculate that lower levels of visual cortical GABA in individuals with deep amblyopia represent a compensatory decrease in inhibition that limits the ability of the amblyopic eye to perceptually suppress the fellow eye.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 912

Development: Structure, assessment

Examination of the applicability of web-based vision tests embedded in games

Poster Presentation - *Topic area: Development: Structure, assessment*

Kazushi Maruya[1] (kazushi.maruya.zb@hco.ntt.co.jp), Kenchi Hosokawa[1,2], Shin'ya Nishida[1,3], Takao Sato[2], Satoshi Nakadomari[4,5]; [1]NTT Communication Science Laboratories, [2]Ritsumeikan University, [3]Kyoto University, [4]Kobe city eye hospital, [5]Next Vision

Collecting data on performance on multiple visual tasks from multiple, diverse samples is useful for examining individual differences of various functions. As a means of large-scale data collection, we developed a set of vision tests embedded in short video games that operate using web browsers and evaluated contrast sensitivity (CS), multiple-object detection (MOD), multiple-object tracking (MOT), and visual crowding (VC). This study aimed to confirm the usability of these tests with large datasets in a variety of contexts outside the laboratory. We conducted experiments using the test set in two contexts with large populations of laypersons. The first was during a digital content convention with primarily young adults in attendance (DC dataset). The other was collected at an eye hospital visited by older adults and their families (EH dataset). Overall, data were available from 1332 participants (DC: n=1256; EH: n=76). The EH and DC datasets were analyzed separately. The two groups showed similar results, which were roughly comparable to the results reported in previous studies. The results of the CS test showed an inverted-U curve peaking at around 2.4 cpd, with a sensitivity of approximately 250. On the VC test, more than half of participants could distinguish target letters at 10 deg eccentricity when they were surrounded by four letters with 5 deg spacing. On the MOT test, participants could track 3–4 moving targets from among 4–5 distractors. On the MOD test, detection sensitivity was consistent between the16 positions within a field of 40 dva. The average time taken by participants to complete was 2–3 min for each test. These findings suggest that the existing tests are a useful assessment for large-scale data collection that involves the examination of the variability and associations between individual differences and multiple visual functions.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 899

Interocular comparison of foveal pit dimensions

Poster Presentation - *Topic area: Development: Structure, assessment*

Nancy Coletta[1] (nancy.coletta@mcphs.edu); [1]MCPHS University, Worcester MA

Optical coherence tomography (OCT) studies indicate that the foveal pit becomes shallower and narrower with increasing myopia. Foveal parameters in fellow eyes have been reported for healthy children. The purpose of this study was to examine how foveal pit dimensions compare in the fellow eyes of adult subjects whose refractions ranged from emmetropia to high myopia. Methods: Measurements were obtained on both eyes of 25 young adults. Refractions ranged from plano to -10.00 D with an average of -3.70 D. The largest interocular difference in refraction was 1.50 D. Axial length was measured with a Zeiss IOL Master. Retinal thickness was measured with an Optovue RTVue spectral domain OCT, using a rotary pattern of twelve 6-mm long scans through the fovea. The following parameters for each scan orientation were computed: maximum thickness on either side of the foveal pit, minimum thickness, pit depth, pit width at the maximum thickness and pit width at half the pit depth. Results: The interocular difference in axial length was correlated with the interocular difference in refraction, with the longer eye being more myopic ($p<0.001$). All foveal dimensions were correlated in fellow eyes ($p<0.001$). The interocular difference in pit width at half depth correlated with the interocular difference in refraction ($p=0.04$), such that the pit was narrower in the more myopic eye. Interocular difference in pit depth was correlated with interocular difference in minimum thickness ($p<0.001$), such that the eye with the shallower pit depth had the thicker foveal minimum. Conclusions: Foveal pit dimensions were very similar in fellow eyes over a range of refractions. Pit width was narrower in the more myopic eye. Pit depth could differ between eyes because of differences in minimum or maximum thickness, but the results indicate that the eye with the shallower foveal pit had greater foveal minimum thickness.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 865

Puberty is Associated with Amygdala Activation during Face Emotion Processing: A Label-Based Meta-analysis Review

Poster Presentation - *Topic area: Development: Structure, assessment*

Junqiang Dai[1], K. Suzanne Scherf[1]; [1]Psychology Dept. Penn state University, University Park

Puberty is a defining feature of adolescent development. It is a biological process that begins with the release of gonadal hormones and unfolds over ~8 years leading to sexual maturation and novel behaviors. Animal models indicate that gonadal hormones induce changes in both perceptual and social behaviors as well as in the functional and structural organization of the adolescent brain. The work investigating how puberty influences adolescent brain and behavioral development in humans is only just emerging. Face processing is one of the primary domains in which researchers have investigated and found effects of puberty on behavior, reporting a pubertal dip in performance, the emergence of a peer bias in face recognition behavior, and dramatic changes in perceptual sensitivity to complex emotional expressions. Given these behavioral findings, we were interested in understanding the extent to which there is convergence in neuroimaging studies assessing the influence of pubertal development on the neural basis of face processing and other social-cognitive domains. To do so, we used a label-based meta-analytic approach to evaluate studies measuring the relation between changes in pubertal development and changes in functional brain development in four domains, including face emotion, reward, social information, and cognitive processing. We found that face emotion processing was the only domain in which there was convergence in the locus of findings. Specifically, more than 50% of studies investigating face emotion processing reported associations between pubertal development and changing functional activation in the amygdala. However, the directionality of these effects (increasing vs decreasing activation with increasing puberty) was not consistent across studies. These findings are consistent with predictions about the potential influence of puberty on amygdala-mediated responses to faces during adolescence (Scherf et al., 2012, 2013).

Acknowledgements: This work was supported by a grant (RO1 MH112573-01) from the National Institute of Mental Health (NIMH) to KSS (email: kss23@psu.edu).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1386

Rapid, precise and objective visual acuity assessment method by combining FrACT and SSMVEPs

Poster Presentation - *Topic area: Development: Structure, assessment*

Xiaowei Zheng[1] (hlydx2324@163.com), Guanghua Xu[1], Yongcheng Wu[1], Yuhui Du[1], Renghao Liang[1], Sicong Zhang[1], Kai Zhang[1]; [1]Xian Jiaotong University, China

Traditional visual acuity test depends on the subjective evaluation, such as the naming of Snellen letters, which is difficult to perform with preverbal children and even adults with suspected malingering or low intellectual abilities. Although steady-state motion visual evoked potentials (SSMVEPs) can provide an objective visual acuity assessment method (Zheng et al., 2019), the time spent on the visual acuity test is a bit long and the spatial frequencies of stimulus are limited, easily leading to visual fatigue and affecting the precision of results. Hence, the combination of the Freiburg Visual Acuity and Contrast Test (FrACT) and SSMVEPs provides an alternative method for rapid and precise visual acuity assessment (Bach, 1996). In this study, we replaced the Landolt-Cs of eight orientations of FrACT with SSMVEP paradigms of eight different temporal frequencies, and the manual response by pressing the buttons of the response box was also replaced by automatic online SSMVEP response by canonical correlation analysis (CCA) method. The visual acuity was defined as the corresponding spatial frequency threshold of the paradigm at the steepest part of the psychometric function of a logistic function (Bach, 2006), and the best PEST (parameter estimation by sequential testing) was used to estimate threshold by using previous response results (Lieberman & Pentland, 1982). Ten subjects participated in this experiment for two minutes of one eye's test, and Bland-Altman analysis found that the agreement between objective SSMVEP and subjective FrACT visual acuity was pretty good. Our study proved that the visual acuity assessment based on the combination of SSMVEPs and FrACT can be an objective, rapid and precise method to measure visual acuity, especially for infants and preverbal children.

Acknowledgements: Supported by grants from the Independent Innovation Capacity Improvement Project of Xi'an Jiaotong University (PY3A071) and the National Natural Science Foundation of China (NSFC-51775415).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 989

Development: Typical

Adolescents' and adults' sensitivity differs around the visual field

Poster Presentation - *Topic area: Development: Typical*

Caroline Myers[1], Marisa Carrasco[1,2]; [1]New York University Department of Psychology, [2]New York University Center for Neural Science

[Purpose] Adult perceptual performance is heterogeneous across the visual field. Visual performance decreases with eccentricity and differs at isoeccentric locations. Performance is better along the horizontal than the vertical meridian (Horizontal-Vertical Anisotropy, HVA) and better along the lower than the upper vertical meridian (Vertical Meridian Asymmetry, VMA). Exogenous (involuntary) attention improves performance, yet preserves the shape of this performance field. These asymmetries are not present in young children. Here, we investigated whether these asymmetries are present in adolescents, and whether their performance fields are modulated by attention. [Methods] Adults (18 to 30 years old) and adolescents (12 to 17 years old) performed a 2AFC orientation discrimination task while maintaining fixation. On each trial, Gabor patches (tilted +/- 20 deg. from vertical) simultaneously appeared at four isoeccentric locations along the vertical and horizontal meridia (6.4 deg. eccentricity). Overall task difficulty was equated across participants using a contrast threshold procedure. Attention was manipulated by presenting either one (valid) or four (neutral) peripheral pre-cues. Observers reported the orientation of the target, indicated by a response cue. Accuracy and response time were measured at each stimulus location. [Results] As expected, in the neutral condition, adult performance showed both a pronounced HVA and VMA for accuracy and speed. In contrast, adolescent performance was similar across the 4 tested locations for accuracy and speed. Exogenous attention improved performance to the same degree at all 4 locations for both adults and adolescents. [Conclusions] The presence of the characteristic HVA and VMA for adults and their absence for adolescents indicate that the shape of the visual performance field significantly changes from adolescence to adulthood. Moreover, exogenous attention improves performance to a similar extent across locations in both populations, preserving the shapes of their corresponding performance fields.

Acknowledgements: Funding source: NIH NEI R01-EY027401

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 873

Domain-general representations of confidence throughout development

Poster Presentation - *Topic area: Development: Typical*

Carolyn Baer[1] (cebaer@psych.ubc.ca), Darko Odic[1]; [1]University of British Columbia

We routinely make decisions that combine independent representations, such as combining vision and audition to decipher speech (McGurk & MacDonald, 1976). Recent work has argued that confidence representations exist in a domain-general format that could facilitate this integration: adult observers can compare their confidence across independent perceptual dimensions (orientation and frequency; de Gardelle & Mamassian, 2014), between auditory and visual stimuli (de Gardelle et al., 2016), and some work hints that this domain-generality might extend to non-perceptual tasks like memory and executive functioning (Mazancieux et al., under review). Here, we test a domain-general confidence hypothesis throughout development, investigating whether confidence is by nature domain-general, or if this emerges with experience. In Experiment 1, 6-7-year-olds compared their confidence in two decisions from the same visual dimension (e.g., number and number) and from two distinct visual dimensions (e.g., number and emotion) with equivalent ability (Fig. 1 and 2), supporting the hypothesis that visual confidence is domain-general in childhood. In Experiment 2, we similarly found that individual differences in certainty comparison are strongly correlated in 6-9-year-olds across otherwise uncorrelated visual dimensions (number, area, and emotion, Fig. 3). In Experiment 3, we extend this work to examine whether this domain-generality also exists between perception and memory in both children and adults. Finally, in Experiment 4, we attempt to identify what the common currency of confidence might be that allows for these cross-domain comparisons, examining whether response times, probability of accuracy, or objective difficulty (the ratio of two quantities) underlie these decisions. Together, our findings support the idea that confidence, particularly perceptual confidence, is represented in a common format even in childhood, providing one account for how independent representations could be compared.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Note that due to data collection restrictions, we were unable to complete Experiment 4 in the abstract.

We're happy to answer questions in the chat, or email cebaer@psych.ubc.ca.

Abstract ID: 1601

Fixation patterns differ as a function of intersensory processing performance during the first three years of life

Poster Presentation - *Topic area: Development: Typical*

Bret Eschman[1] (beschman@fiu.edu), James Torrence Todd[1], Lorraine E. Bahrick[1]; [1]Florida International University

Selective attention to intersensory redundancy (stimulation that is temporally synchronized across the senses) guides cognitive, social, and language development (Bahrick and Lickliter, 2012). Recently, Bahrick et al. (2018) developed the intersensory processing efficiency protocol (IPEP), the first fine-grained, nonverbal method for characterizing individual differences in intersensory processing suitable for infants and young children. Participants must find a sound-synchronized visual target social (women speaking) or non-social (objects striking a surface) amid five visual distractor events, simulating the “noisiness” of natural environments. While detection of intersensory redundancy is foundational for cognitive, social, and language development, few studies have examined the role of low-level visual fixation patterns that give rise to detecting redundancy. The current poster explores the extent to which these visual dynamics differ as a function of intersensory processing accuracy (measured via the IPEP) during the first three years of life. A total of 106 infants completed the IPEP, longitudinally at 3, 6, 12, 18, 24, 36 months of age. Their eye gaze was recorded with a Tobii TX-120 eye-tracking system. Across all ages, children made more fixations and had shorter average fixation durations on trials in which they located the target (synchronous audiovisual event) compared to trials in which they did not locate the target (ps <.01; Figures 1 and 2). Importantly, these metrics do not seem to be the product of “in the moment” differences in factors such as attention and/or arousal as correlational analyses reveal relative stability across age (Table 1). Taken together these results suggest: 1) Quantifying the length and number of fixations may provide useful new predictors of intersensory processing, 2) the visual dynamics identified in this poster appear relatively stable across the first three years, and 3) these visual dynamics could provide more fine-grained predictors of later cognitive, social, and language outcomes.

Acknowledgements: This Research was supported by NIH grants RO1-HD094803 & RO1-HD053776-11 awarded to the last author.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 415

Neural sensitivity to natural texture statistics changes during middle childhood.

Poster Presentation - *Topic area: Development: Typical*

Benjamin Balas[1] (benjamin.balas@ndsu.edu), Shea Lammers[1], Alyson Saville[1]; [1]North Dakota State University

Natural images have lawful statistical properties that the adult visual system is sensitive to, both in terms of behavior and neural responses to natural images. The developmental trajectory of sensitivity to natural image statistics remains unclear, however. In behavioral tasks, children appear to slowly acquire adult-like sensitivity to natural image statistics during middle childhood (Ellemberg et al., 2012), but in other tasks, infants exhibit some sensitivity to deviations of natural image structure (Balas & Woods, 2014). Here, we used event-related potentials (ERPs) to examine how sensitivity to natural image statistics changes during childhood at distinct stages of visual processing (the P1 and N1 components). We recruited 48 participants (5-7 year-olds, N=16; 8-10 year-olds, N=16, Adults, N=16) , who viewed natural texture images with either positive/negative contrast, and natural/synthetic texture appearance (Portilla & Simoncelli, 2000). We hypothesized that children may only acquire sensitivity to these deviations from natural texture appearance late in middle childhood, consistent with previous results suggesting that texture and material processing follow a local-to-global developmental trajectory (Balas et al., 2019). We measured the P1/N1 mean amplitude and latency over occipital sensors in all participants. We observed significant interactions between contrast and age group for P1 latency, and between texture statistics and age group for N1 amplitude. Both effects reflect greater sensitivity to natural image appearance in children compared to adults. In particular, we observed no effects of image contrast in adults, while young children exhibited a latency effect at the P100. Sensitivity to contrast negation was also evident in young children at a late component (~350ms) that in older children and adults was only sensitive to texture statistics. We discuss these results in terms of changing patterns of invariant texture processing during middle childhood and ongoing refinement of the representations supporting natural image perception.

Acknowledgements: National Science Foundation, DS-1727427

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

You can follow me on Twitter at @bjbalas - Thanks for your interest in this work, and please feel free to contact me with any questions or comments!

Abstract ID: 180

Retinotopic mapping with fMRI in awake, behaving infants

Poster Presentation - *Topic area: Development: Typical*

Cameron Ellis[1] (cameron.ellis@yale.edu), Tristan Yates[1], Lena Skalaban[1], Vikranth Bejjanki[2], Michael Arcaro[3], Nicholas Turk-Browne[1]; [1]Yale University, [2]Hamilton College, [3]University of Pennsylvania

Drastic changes in visual processing occur in the first years of life, yet little is known about how visual cortex develops during this period in humans. Retinotopic mapping has been performed in children as young as five, and the organization of their visual cortex was found to be adult-like (Gomez et al., 2018). However, whether this is true in younger infants and toddlers is unclear. On one hand, visual acuity and functions improve substantially over the first 12 months (Maurer & Lewis, 2001), suggesting that visual cortex may undergo reorganization. On the other hand, a hierarchical and topographic proto-organization has been observed from birth in non-human primates (Arcaro & Livingstone, 2017). Here we investigate how the organization of human visual cortex develops by conducting retinotopic mapping using fMRI in infants. Retinotopy in infants is a challenge for two key reasons: (1) they provide low quantities of data because of motion and fussiness, and (2) it is not possible to ensure fixation during stimulus presentation. These issues make modern travelling-wave paradigms infeasible. We instead adopted block designs that were robust to eye movements: meridian mapping to identify polar-angle boundaries between areas (Schnieder et al., 1993) and full-field spatial frequency modulation to map eccentricity (Arcaro & Livingstone, 2017). These tasks engaged infants, allowing us to obtain sufficient data in 6 sessions with 5 infants between 5 and 18 months. In all participants, we observed strong and selective evoked fMRI activity in visual cortex that distinguished horizontal versus vertical meridians and high versus low spatial frequencies. In infants over a year old, for whom we have succeeded in making surface reconstructions for flat mapping, we see clear evidence of hierarchically and topographically organized visual areas. In these participants, we are able to delineate and quantify regions up to ventral V4 and dorsal V3.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 181

Temporal regularities guide spatial attention in young children

Poster Presentation - *Topic area: Development: Typical*

Nir Shalev[1,2,3] (nir.shalev@wolfson.ox.ac.uk), Hannah Wilkinson[1], Sage Boettcher[1,2,3], Gaia Scerif[1], Anna Christina Nobre[1,2,3]; [1]Department of Experimental Psychology, University of Oxford, [2]Wellcome Centre for Integrative Neuroscience, University of Oxford, [3]Oxford Centre for Human Brain Activity, University of Oxford

A fully developed human mind constitutes a predictive system, continuously exploiting regularities in our environment to anticipate events proactively. However, it is unknown whether this fundamental property of behaviour exists in younger ages. There are certain trade-offs between cognitive abilities most relevant at childhood vs. adulthood. For example, the system may favour learning and exploration in early development, and goal-driven exploitation in adulthood. Recently, we developed a novel visual search task, in which participants detect multiple targets appearing and disappearing dynamically amidst distractors. In adults, spatial-temporal regularities implicitly facilitate performance. We adapted this task for testing five-year-old observers (N=87). On each trial, children searched for eight targets which appeared among distractors in a dynamic display. We used images of airplanes, bugs, and birds as targets and distractors, which gradually appeared and disappeared on a textured background split into four quadrants (see appendix) over extended trials lasting ~12 seconds. The target category was assigned randomly at the beginning of the first experimental block, and then replaced in the second one. Participants used a touch screen to indicate detected targets. Critically, four out of eight targets were predictable in their onset time and spatial quadrant, while the other four appeared at random times and locations. Participants found significantly more predictable compared to unpredictable targets, indicating that children learned the spatial-temporal associations and anticipated task-relevant events (see appendix). This effect appeared over the two blocks, highlighting a flexible capacity of learning new regularities. More broadly, we discovered that young children are capable of implicitly learning complex spatial-temporal regularities, and form predictions to anticipate task relevant events. As this capacity could be highly relevant for the typical development of goal-directed behaviour, we additionally report how various task markers relate to teacher reports of attention differences, and compare performance with a group of neurotypical adults.

Acknowledgements: Wellcome Trust Senior Investigator Award (104571/Z/14/Z) and a James S. McDonnell Foundation Understanding Human Cognition Collaborative Award (220020448) to A.C.N. The Wellcome Centre for Integrative Neuroimaging is supported by core funding from the Wellcome Trust (203139/Z/16/Z).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Feel free to email me for more details, or if you'd like to chat about the poster: nir.shalev@psy.ox.ac.uk

Abstract ID: 1050

The integration of position and motion signals for object tracking in childhood

Poster Presentation - *Topic area: Development: Typical*

Matteo Lisi[1] (matteo_lisi@yahoo.it), Cleanthis Michael[2], Tessa Dekker[3]; [1]Essex University, [2]University of North Carolina at Chapel Hill, [3]University College London

Determining where objects are located in space is a fundamental function of the visual system. When objects are moving, position information can be combined with visual motion signals to improve localization accuracy and compensate for delays in sensory-motor pathways. Previous studies have shown that adults integrate position and motion signals optimally or nearly so (Kwon et al, 2015), but how and when this ability develops is unknown. Up to ~8-11 years, children do not optimally account for uncertainty when integrating different sensory cues. Does this extend to position-motion integration for predictive object tracking? To test this, we measured motion-induced position shifts (MIPS) in adults and children 6- to 10- years old. Participants judged the relative heights of two stimuli left and right of fixation, consisting of 1/f luminance noise presented within a Gaussian contrast envelope. The noise pattern could either drift coherently upward or downward, inducing a perceived position-shift. We varied eccentricity, presentation duration, and speed of the internal pattern motion. To assess precision of position judgments, we included trials in which the internal pattern varied with no coherent direction. We found that even after taking attention lapses into account, children exhibited much larger variability in position judgments (just noticeable differences in children <8 years were ~4 times larger than in adults), indicating larger positional uncertainty. However they showed only a trend for a small increase in MIPS magnitude, smaller than predicted by optimal visual tracking models (Kwon et al, 2015). Taken together, these findings suggests that children do not fully account for their positional uncertainty when combining position and motion signals. Similar to other sensory integration processes (e.g., Dekker et al, 2015), mechanisms underlying position-motion integration might undergo a prolonged developmental trajectory during childhood, and may contribute to improvements in object interception.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for checking our poster. The poster should be self-explanatory, and I also made a video providing a walkthrough, available at this link:

https://drive.google.com/file/d/1y6_tnT4DDY6LzWnh-IJAph_4b5a1dWKz/view?usp=sharing

It's about 8 min, too long for VSS website but I didn't have time to re-record it, feel free to fast-forward through the meandering bits :)

Please do get in touch for any comments or suggestions, or if you'd like to chat about this "face to face", e.g. via Zoom or Skype.

m.lisi@essex.ac.uk
https://mlisi.xyz/

Abstract ID: 1784

Visual temporal integration windows are longer in infants

Poster Presentation - *Topic area: Development: Typical*

Julie Freschl[1] (julie.freschl001@umb.edu), David Melcher[2], Zsuzsa Kaldy[1], Erik Blaser[1]; [1]University of Massachusetts Boston, [2]University of Trento

The visual system balances two complementary processes: temporal integration to construct stable representations, and segmentation to resolve change. This balance point can be captured by the 'Temporal Integration Window'. If two stimuli fall within the same TIW, they are integrated; otherwise, segmented (VanRullen 2016). Previous work has suggested that temporal processing is slower in infants (Farzin et al. 2010). We tested this using a novel, gaze-based 'pop-out' search paradigm to measure TIWs in 5 to 13 month olds (N= 34; mean= 8.3 months, SD= 2.7 months). Trials consisted of a 4 s sequence of two alternating displays (ABAB…) containing search stimuli distributed in a 4x4 grid. Infants were tasked with finding a circle-shaped target - if fixated, the trial was coded as correct. On integration trials, display A consisted of 8 half-circles, and B, 9 half-circles. Alone, displays A and B contained no target, but if integrated, the circle target was formed by the alignment of two complementary half-circles. On segmentation trials, display A consisted of 15 half-circles, and B, 15 complementary half-circles, plus one full circle. Combined, this appeared as a field of undifferentiated circles, but if segmented, the single circle target was visible. Pace (SOA) was dependent on trial (integration: 33, 67, 133 ms; segmentation: 67, 133, 267 ms). Shorter SOAs facilitate integration performance, and longer, segmentation. TIWs were estimated by finding the intersection of the integration and segmentation performance functions for the group (Wutz et al. 2016). Data collection is ongoing, but preliminary analyses show infants have a TIW of 128 ms, much longer than our comparison group of adults (TIW= 55 ms), or our previous work with adults and 5-7 year-olds (TIWs of 73 and 68 ms, respectively) (Freschl et al. 2019). This suggests that infants are relatively slow; a conservative bias toward stability over speed.

Acknowledgements: This project was supported by a grant from the National Institute of Mental Health (R21MH117787).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1639

Eye Movements: Blinks, pupil, pursuit, vergence

Change in Pupil Size Reveals Impact of Simulated-Cochlear Implant Speech on Listening Effort

Poster Presentation - *Topic area: Eye Movements: Blinks, pupil, pursuit, vergence*

Jessica Defenderfer[1] (jdefende@uthsc.edu), Mary McGarr[2], A. Caglar Tas[2]; [1]University of Tennessee Health Science Center, [2]University of Tennessee Knoxville

The present study used pupillometry to assess listening effort in normal-hearing adults during a speech perception task. Early research on speech perception relied on self-report or subjective measures to assess effortful listening, while more recent studies employ objective measures to better quantify listening effort in various listening conditions. Further, audiological evaluations reveal that cochlear implant (CI) recipients experience greater difficulty understanding speech due to the spectrally-degraded quality of speech input. To test this, Defenderfer et al. (2017) measured neural activation to investigate the effect of speech quality in normal-hearing adults using speech-in-quiet, simulated CI-speech (vocoded), and speech in background noise (SIN). The SIN condition was associated with significant increases in neural activation, yet no significant differences were observed between speech-in-quiet and vocoded conditions, despite the degraded quality of vocoded speech. Expanding on these findings, the present study used pupillometry to elucidate the impact of vocoded speech on listening effort. Changes in pupil size have been shown to reflect the amount of cognitive resources required to carry out a task; hence, the pupil response may be more sensitive than neural measures at detecting effort. Using the same conditions as in Defenderfer et al. (2017), we recorded pupil size while normal-hearing adults performed a speech perception task. First, mean pupil sizes were significantly larger when participants were listening to the sentences compared to the pre-sentence baseline (-1000ms) for all three conditions. This effect increased as the quality of speech became more difficult, suggesting greater effort. Specifically, changes in pupil size were greatest for the SIN condition (M=248 a.u./16% change) followed by the vocoded (M=160 a.u./11% change) and then by

speech-in-quiet (M=45 a.u./3% change). These results indicate that vocoded speech demands more cognitive resources than speech-in-quiet, suggesting that pupillometry is a more sensitive measure of effort than neural measures during listening tasks.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1409

Closing in on a potential biomarker for early detection of autism: Reduced pupil responses to repeated multisensory stimuli in young children with autism

Poster Presentation - *Topic area: Eye Movements: Blinks, pupil, pursuit, vergence*

Jonathan Doyon[1,2] (jdoyon@gwu.edu), Ashley Darcey-Mahoney[1], Chynna Golding[1], Sarah Shomstein[1,2], Gabriela Rosenblau[1,2]; [1]Autism and Neurodevelopmental Disorders Institute, George Washington University, [2]Department of Psychological and Brain Sciences, George Washington University

Autism spectrum disorder (ASD) is characterized by hypersensitivities to sensory stimuli which may result from deficits in habituation, i.e., encoding temporal regularities in the environment and adapting predictions accordingly. Here, we investigate whether changes in pupil dilation—decreases of pupil diameter (PD) over time—are a useful biomarker for attenuated habituation to multisensory stimuli in young children with ASD. Neurotypical (n = 27, M = 44.58 mos., SD = 14.14) and ASD (n = 7, M = 50.37 mos., SD = 15.76) participants viewed repeated audio-visual stimuli of varying complexity: from discrete beeps with continuous optic flow field to naturalistic movies. PD changes were tracked with the remote Eyelink 1000 plus tracker that allows free head movement. We extended preprocessing pipelines in the PsychoPhysiological Modeling toolbox to clean data and correct for blinks, saccades, and system artifacts. Regression modeling indicated that neurotypical (NT) and ASD participants showed different PD trajectories with trial repetitions depending on stimulus complexity. In the lowest complexity condition (beeps), both groups showed attenuation of PD responses throughout the experiment. The time course and structure, however, differed: NT participants' PD decreased linearly over time, while ASD participants' PD followed a quadratic trajectory, i.e., pupil size increased through the first third of the experiment and decreased thereafter. In the more complex audio-visual animation condition, PD decreased quadratically with time in

both groups. Neither group showed PD habituation to the most complex stimulus—the naturalistic movie scene. These results provide preliminary evidence that pupillary responses can measure differences in sensory processing and habituation between NT and ASD groups. Our results also suggest that habituation differs for low and highly complex stimuli. Next, we will use computational modeling to identify finer-grained group differences in habituation to complex stimuli, with the goal of establishing a biomarker for habituation deficits in autism.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1495

Contribution of retinal and extra-retinal signals for oculomotor priors

Poster Presentation - *Topic area: Eye Movements: Blinks, pupil, pursuit, vergence*

Alexander Goettker[1] (alexander.goettker@psychol.uni-giessen.de), Karl Gegenfurtner[1]; [1]Justus Liebig University Giessen

To overcome internal processing delays, the oculomotor system uses a integration of prior stimulus movements and the current sensory input to adjust the initial eye speed. We investigated the roles of retinal and extra-retinal signals as prior information. Each trial consisted of a specific movement sequence: (1) a 15 deg/s baseline movement of a Gaussian blob across the screen, during which the participants kept fixating. (2) A prior movement, where the same physical target movement took place, but observers pursued the target. The starting position of the movement was chosen to create variability in the initial oculomotor behavior. Some trials were tracked with pure pursuit vs. some trials were tracked with pursuit and an additional forward corrective saccade, some trials with pursuit and an additional backward corrective saccade. (3) A 15 deg/s test movement to investigate the influence of the prior. This was the same as the baseline movement, but now observers pursued the target. For this movement, the starting position was chosen to minimize initial saccades. The occurrence of a corrective saccade during the prior movements allows to disentangle the contributions of extra-retinal and retinal information. A forward corrective saccade leads to higher extra-retinal velocity while reducing the retinal velocity compared to the same physical trial without a saccade. The results showed an effect of the corrective saccades in the prior movement on pursuit speed in the test phase. In comparison to trials with pure pursuit, the eye speed in the test movement was slower after prior movements with forward saccades, even though both eye speed and perceived speed were higher in this case. In contrast, trials with additional backward saccade produced

the opposite pattern of results, suggesting that retinal speed seems to be more important in forming oculomotor priors than extra-retinal signals or perceived speed.

Acknowledgements: Funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation)—project number 222641018— SFB/TRR 135 Project A1, and by the DFG International Research Training Group 1901.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for the interest in our poster.
If you have further questions or want to chat about the project feel free to contact me under Alexander.Goettker@psychol.uni-giessen.de

Abstract ID: 631

Errors in predictive smooth pursuit across blinks are explained by temporal compression.

Poster Presentation - *Topic area: Eye Movements: Blinks, pupil, pursuit, vergence*

Arnab Biswas[1] (arnabbiswas@ntu.edu.sg), Li Yan Chloe Neo[1], Gerrit W Maus[1]; [1]Psychology, School of Social Sciences, NTU, Singapore

We blink frequently, yet most of our eye blinks go unnoticed because of suppressed visual input during blinks. To maintain visual continuity in a dynamic world, we need to predict the behavior of objects during visual suppression. For example, while tracking a moving object, we would ideally minimize the pursuit error at the moment our eyes open after a blink, by predicting the motion of the object. In this experiment, we used a 2AFC task to investigate if participants (N=23) performing a horizontal smooth-pursuit could determine perceptually if the target had jumped forward or backward during an eye blink. The behavioral data indicates that participants consistently perceived backward jumps as more continuous. We also analyzed participants' gaze data during the task to compare the smooth pursuit gain at the instant just before and after the blink. We found that the pursuit gain was reduced just after the blink, i.e., gaze was lagging behind the target. During the period of eyelid closure, there is no retinal slippage. Hence, we need to rely on our internal prediction model to accurately estimate the target motion. Many studies have shown that we underestimate the duration of eye blinks. Assuming that pursuit accuracy before the blink is

an indication of the robustness of our internal model, a possible explanation for the decrease in pursuit gain might be that our prediction model uses an underestimated duration of eye blinks to predict target locations after blinks. Thus, the temporal underestimation of a blink may later manifest as a spatial underestimation in the form of a pursuit error. To test this, we modeled the subjects' smooth pursuit across blinks using kinematics. Our model shows that the duration of a blink is compressed by about 61%, consistent with values reported in recent studies.

Acknowledgements: This research was supported by Nanyang Technological University starting grant awarded to Gerrit Maus (NAP-SUG).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for taking a look at our poster. If you have any questions, please write to arnabbiswas@ntu.edu.sg

Abstract ID: 484

Eye-head coordination during exploration of 360-degree scenes in virtual reality

Poster Presentation - *Topic area: Eye Movements: Blinks, pupil, pursuit, vergence*

Oliver Jacobs[1] (ojacobs@psych.ubc.ca), Nicola Anderson[1], Alan Kingstone[1]; [1]University of British Columbia

People naturally move both their head and eyes to attend to information. Yet, studies of attentional orienting normally immobilize the head in a chin rest in order to focus on eye movements, thus questioning their ecological validity. Here, using a virtual reality headset with built-in eye tracking, participants were asked to view indoor and outdoor, fully immersive, 360-degree scenes while their head and eyes were tracked. In order to investigate eye-head coordination, participants viewed the scenes through a small moving window that was yoked either to their head or eye movements. We found that perturbations induced by the head- or gaze-contingent windows affected head and eye movements differentially, in line with their distinct roles in head-eye coordination. Compared with windowless viewing, gaze-contingent viewing was more disruptive than head-contingent viewing, indicating a functional separation between

head and eye. Indeed, gaze-contingency actually decreased the coupling between head and gaze movements in 360-degree scene exploration, while head-contingent viewing looked more like windowless viewing. These data dovetail with the nested effectors hypothesis, which proposes that the head prefers exploration into non-visible space while the eyes prefer to exploit visible areas delivered by the head. It also suggests that real-world orienting may be much more head-based than previously thought. We discuss our findings in relation to the cognitive repercussions of eye vs. head movements, as well as highlighting the utility and ecological validity of unconstrained eye and head tracking in virtual reality.

Acknowledgements: This work was supported by the Natural Sciences and Engineering Research Council of Canada.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 571

Lags and leads of accommodation: Fact or fiction?

Poster Presentation - *Topic area: Eye Movements: Blinks, pupil, pursuit, vergence*

Martin Banks[1] (martybanks@berkeley.edu), Vivek Labhishetty[2], Steven Cholewiak[3]; [1]UC Berkeley

Conventional wisdom is that accommodation in humans exhibits significant errors. When the stimulus is far, the eye is thought to focus too near (“lead of accommodation”). When the stimulus is near, it focuses too far (“lag”). These errors are as large as 1 diopter, which should produce noticeably blurred imagery. But viewers typically do not experience the blur expected from such leads and lags. We re-examined this phenomenon by measuring accommodation objectively and subjectively. Objective measurements are based on measurements of light reflected off the retina. Subjective measurements are based on the viewer performing a visual task; they are more valid because they involve the whole visual process. We used a custom varifocal display apparatus to present accommodative stimuli to six young adults. On each trial, subjects fixated and focused on a Maltese cross at a distance of 0, 2, 4 or 6D. A wavefront sensor measured accommodation (and pupil size) objectively. During the 3-sec presentation of the cross, we also measured acuity with flashed tumbling E’s presented at different distances. Subjects indicated the E’s orientation at the end of each presentation. Percent correct was determined for each of eight distances of the E relative to the accommodative stimulus. Each subject experienced 1600 trials (4 accommodative stimulus distances, 8 E distances, and 50 repetitions). The objective measurements from the wavefront sensor revealed typical

lags and leads. The subjective measurements revealed much smaller lags and leads. Thus, by subjective measurement, the eye appeared to be focused quite accurately at the distance of the fixation stimulus. We conclude that errors of accommodation have been overestimated. The eye is better focused at the stimulus distance than previously thought. Our observations have important implications for the understanding of accommodation, the development of myopia, and next-generation head-mounted displays.

Acknowledgements: NSF, Intel, Huawei, Applied Materials, CIVO

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

It's not that complicated. Accommodation in the service of visual performance is more accurate than previously thought. Chat sessions on Friday, June 19.

Abstract ID: 1650

Speed-accuracy tradeoff of visual search: Modulation of pupil size

Poster Presentation - *Topic area: Eye Movements: Blinks, pupil, pursuit, vergence*

Jeffrey D. Schall[1] (jeffrey.d.schall@vanderbilt.edu), Thomas R. Reppert[1]; [1]Vanderbilt University

Understanding visual decision-making entails understanding how speed-accuracy tradeoff (SAT) is accomplished. Investigations of human SAT with non-invasive measures have demonstrated variation of multiple processes and brain regions. Investigations of monkey SAT with neurophysiological measures have also demonstrated variation of multiple types of neurons in diverse structures. Neural signals in both species indicate network-wide gain changes underlying SAT. Previous work with humans showed that pupil diameter is a reliable index of global neural gain during speed-accuracy tradeoff. To assess the ubiquity of SAT effect on neural gain, we investigated changes in pupil dilation and constriction during visual search. Four macaque monkeys performed visual search to locate a target (T/L) presented amongst seven distractors (L/T) with overall luminance equated across array configurations. Trials began when monkeys fixated a central stimulus, the color of which cued emphasis on response speed (green for Fast condition) or accuracy (red for Accurate condition). For each monkey, response time was shorter, and choice error rate, higher, in the Fast relative to the Accurate condition. We found robust pupil dilation during the baseline period before array appearance. The rate of dilation was greater in the Fast relative to the Accurate condition. Notably, pupil dilation did not predict occurrence of response errors in choice or timing. These new observations replicate previous reports of larger pupil size when speed is emphasized and reinforce the hypothesis that pupil size is an overt marker of covert gain changes that accomplish SAT.

Acknowledgements: This work was supported by NIH (F32-EY019851, T32-EY07135, R01-EY019882, and R01-EY08890), and by Robin and Richard Patton through the E. Bronson Ingram Chair in Neuroscience.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1338

Eye Movements: Cognition and complex stimuli

Beyond the screen's edge: eye and head movements while looking at rotated scenes in VR

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Nicola C Anderson[1] (nccanderson@gmail.com), Walter F Bischof[1,2], Alan Kingstone[1]; [1]University of British Columbia, [2]University of Alberta

We examined the extent to which image shape (square vs. circle), image rotation, and image content (landscapes vs. fractal images) influenced eye and head movements. Both the eyes and head were tracked while observers looked at natural scenes in a virtual reality (VR) environment. In line with previous work, we found a bias for saccades in line with the image horizon for landscape images, and unusually, for fractal images as well. Interestingly, when viewing landscapes, but not fractals, observers rotated their head in line with the image rotation, thereby enabling saccades to be made in cardinal, rather than oblique directions. This clear distinction between how the eyes and head respond to image content suggests that they may be subserved by different control strategies. We discuss our findings in relation to current theories of attentional control, and how insights from VR might inform past and future eye-tracking studies.

Acknowledgements: Natural Sciences and Research Council of Canada

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

This work is about eye and head movements in a virtual environment - I hope you like it!

Here's a link to the preprint: https://psyarxiv.com/r5ays/

Abstract ID: 560

Effects of task complexity and working memory load on eye-tracking indices of cognitive effort in adults and children

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Valentina Bachurina[1] (vabachurina@gmail.com), Marie Arsalidou[1]; [1]National Research University Higher School of Economics

Cognitive effort a subjective phenomenon, generally defined as the amount of sustained mental activity, exerted during a cognitive task. A well-established eye movement indice of cognitive effort is blink rate. Many studies show that in cognitive tasks that involve visual stimuli blink rate decreases as a function of difficulty (Maffei, & Angrilli, 2018). Working memory (WM) is a core cognitive ability and refers to the number of items or schemes that can be simultaneously held and manipulated in mind. While a great deal of studies have explored behavioral correlates of WM load and task complexity, little is known about how these relate to eye movements across development. We implement an eye-tracking paradigm to study effect of complexity and WM load on eye movements from a developmental perspective. 57 healthy adults (23 male., age = 23.25±3.6) and 26 children (10 male, age = 9.53±0.76) participated in the study. Eye-tracking data was recorded with the EyeLink Portable Duo, while participants performed the Colour Matching Task (Arsalidou et al., 2010). During the CMT the participant is shown a picture with multiple colours for 3 s. and gives a response at the following picture: are the colours same or different. CMT has 6 levels of WM load: the number of relevant colors and two levels of task complexity (low and high interference conditions). Analyses of variance showed a significant main effect of age group on blink rate ($p < 0.01$, $F = 9.091$, $\eta 2 = 0.009$) with children making less blinks in all levels of WM load, as well as significant main effect of WM load ($p < 0.001$, $F = 130.5$, $\eta 2 = 0.021$) with blink rate decreasing as WM load increased. No significant effects were observed for task complexity. Results will be discussed in terms of cognitive development and implications to education.

Acknowledgements: Support is gratefully acknowledged from the Russian Science Foundation (#17-18-01047)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1069

Eye movements reveal event understanding in visual narratives

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Karissa B. Payne[1] (karipayne@ksu.edu), Maverick E. Smith[1], John P. Hutson[2], Joseph P. Magliano[2], Lester C. Loschky[1]; [1]Kansas State University, [2]Georgia State University

What guides eye movements while viewing visual narratives? More specifically, do comprehension processes influence attentional selection when reading wordless picture stories? According to the Scene Perception & Event Comprehension Theory (SPECT) there are front-end processes, such as attentional selection, that occur during single eye fixations, and back-end processes, such as building an event model, that occur in working memory and long-term memory. Here we have investigated how attentional selection may be influenced by event models while people view visual narratives. Prior research has shown that as more situational changes occur in a visual narrative (e.g., space, time, characters, goals and sub-goals), viewers are more likely to perceive an event boundary (i.e., beginning of an event) (Magliano et al., 2011). Other research has shown that viewing times increase at event boundaries (Hard, Recchia & Tversky, 2011; Smith, Newberry & Bailey, 2019). In an eye-tracking study using the “Boy, Dog, Frog” picture stories, we replicated the findings that spatiotemporal and character changes produced higher event segmentation. We also replicated the findings that viewing time was longer at event boundaries. We then extended those findings to eye movements. We asked whether the longer viewing times at event boundaries, when more event indices changed, were due to longer fixations (i.e., increased processing load), or more fixations (i.e., more search for information). Longer viewing times were strongly associated with more fixations, not longer fixations, supporting the search hypothesis. Both viewing times and the number of fixations were found to be significantly predicted by spatiotemporal changes, character changes, and the beginning of superordinate goals. Further analyses will assess whether these additional fixations are simply allocated to the new and salient content in an image, or if they are also specifically directed towards the contents necessary to make inferences about the characters’ goals in the narrative.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 6:00 pm EDT America/New_York

Presenter's Message

Link to sign up for information on upcoming journal article:
https://docs.google.com/spreadsheets/d/1I5jUY2i05ohTVVAiy7--w-CnYisCuJj1nCmgLDLv5P4/edit?usp=sharing

Abstract ID: 1645

Foveal and peripheral vision for assessing the quality of computer-generated images

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Vasiliki Myrodia[1], Samuel Delepoulle[2], Laurent Madelain[1,3]; [1]University of Lille, UMR CNRS 9193 - SCALab - Sciences Cognitives et Sciences Affectives, F-59000 Lille, France, [2]Universite Cote d Opale - LISIC - Laboratoire d Informatique Signal et Image de la Cote d Opale, Calais, France, [3]Aix Marseille Universite, UMR 7289 CNRS, Institut de Neurosciences de la Timone, Marseille, France

Computer-generated images (CGIs) are commonly used in printed and electronic media. The algorithms used to produce photorealistic CGIs induce visual noise, which varies inversely with computation time. Our research aims at improving this process by decreasing the computing time without a detectable loss of visual quality. This study is based on our previous work, quantifying the 50% perception threshold (PT) for each participant. To compare foveal versus peripheral information extraction, we conducted two experiments using sets of images at different stages of computation (i.e. with various noise levels) from two different CGIs. In both experiments, each image was cut and then merged with the highest quality image (reference image; RI). Participants were asked to report whether the displayed pictures were composed of two different images or a single one in a 2AFC task. In Experiment 1 (n=20), we investigated the observer's ability to assess the image quality using only peripheral vision. For the peripheral vision, we displayed pictures composed of the RI and the PT-image. For the central vision, we used a gaze-contingent paradigm to display the highest quality image through a Gaussian transparency mask at the gaze position. The mask diameter was adjusted on each trial using a QUEST+ Bayesian adaptive method. Results indicate that a mask of about 100 pixels (3.62deg) significantly impairs the observer's ability to report a quality difference. In Experiment 2 (n=4), we recorded the observers’ scan-paths of scene exploration while performing the 2AFC task. The composed picture used three categories of images depending on the amount of noise (high, at PT, and low). Results show longer fixation durations in information-rich areas. Furthermore, participants are capable of reporting the quality difference for the high-noise and PT-images. These data reveal how visual information is extracted to detect different CGI qualities and could help optimizing CGI computation.

Acknowledgements: Funding from ANR grant ANR-17-CE38-0009

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 2:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 355

Habitual scanning bias in complex problem solving

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Frances G. McCormick[1] (grace.mccormick@mail.utoronto.ca), Dirk B. Walther[1,2], Karen F. Bernhardt-Walther[3]; [1]University of Toronto, [2]Samsung Artificial Intelligence Center Toronto, [3]York University

Habitual scanning direction biases performance on perceptual tasks such as characterizing the shading of an object (Smith et al. 2015) or the symmetry of a scene (Afsari 2016). But how does this spatial bias affect complex problem solving? More generally, how do perceptual patterns affect cognitive outcomes? We employ Ravens-like puzzles as a new experimental paradigm to reflect problem solving with directional bias. Based on work of Matzen et al. (2010), we consistently vary complexity and puzzle attributes, including direction of change. In a preliminary eye-tracking study, we find that scanning patterns for our Ravens-like puzzles are predominantly horizontal, but also vary by directionality of puzzle attributes. Do participants solve puzzles more correctly when puzzle directionality corresponds to habitual scanning direction? If so, this suggests an extension of models for predicting Ravens-like puzzle performance to include directional factors (Hayes et al. 2011). If scanning direction does not affect correctness, this suggests a disjoint between habitual behaviour and top-down attention in spatial problem solving. We conduct a behavioural experiment to isolate the effects of habitual scanning patterns on puzzle-solving performance. We analyze correctness for two groups of Ravens-like puzzles: puzzles with counter-habitual bias, or attribute directionalities which elicit more vertical scanning, and puzzles without counter-habitual bias. To ensure that variation in other puzzle attributes is identical between these two groups, we generate a set of transposed puzzles where each puzzle and its transpose have opposite directional biases. We then compare performance on all puzzles with and without counter-habitual bias. We find that puzzles with counter-habitual bias correspond with significantly lower correctness. This finding indicates that people perform better on complex visual problems where bottom-up directional bias matches habitual trends of perception. More broadly, it suggests continuity between perceptual patterns and cognitive outcomes in a complex task setting.

Acknowledgements: We thank the University of Toronto and the University of Toronto Excellence Award for funding this work. We also thank Chengcheng Huang, Agnes Priscilla Layarda, Rida Aamer, Chris Dobronyi, Jiongtian Guo, and Professor Wil Cunningham for their continued support.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

23 June, 11:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 926

How sound influences gaze when we watch movies

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Lauren Y. L. Cao[1], Stephanie Yung[1,3], Winnie Wang[1], Dirk B. Walther[1,2]; [1]University of Toronto, [2]Samsung Artificial Intelligence Center Toronto, [3]Toronto Rehabilitation Institute

Movies tightly control their audience's attention, eliciting higher levels of eye movement synchrony than unedited footage of natural scenes or amateur videos (Dorr et al. 2010; Hasson et al., 2008). Existing research on the influence of sound on visual attention during movie viewing has shown that viewers follow speech turn-taking more closely when hearing related sound (Coutrot & Guyader, 2014). Here, we seek to examine the degree to which sound contributes to the strong attentional synchrony elicited by Hollywood films. We recorded eye movements for subjects watching commercial films paired with the movie's original soundtrack (original sound condition), the soundtrack from another movie (alternate sound condition), or white noise (ambient sound condition). Ninety-two participants each viewed six movie clips, two in each sound condition. Using inter-subject correlation (ISC) analysis, we examined how sound influences participants' eye movements. We calculated ISC between participants who watched the same movie paired with different soundtracks: original vs. original (ceiling), original vs. alternate, and original vs. ambient. We also computed the ISC between participants who watched different movies paired with the same soundtrack and the ISC of participants watching different movies paired with different soundtracks (floor). We calculated ISC using all eye movements made within an experimental block as well as time-resolved ISC using a sliding time-window. Additionally, we used multiple regression to identify the visual and auditory characteristics that elicit strong attentional synchrony. We found that pairing movies with a non-original soundtrack lowers similarity in eye movements between viewers for all movies analyzed. Auditory characteristics also influence time resolved ISC. Overall, these findings show both sound and image factor in the control that movies exert over our gaze with visual information playing the chief role in guiding attention. Our results offer insight into how sound contributes to the attentional synchrony elicited by Hollywood films.

Acknowledgements: This work was supported by an NSERC Discovery Grant (#498390), the Canadian Foundation for Innovation (#32896) to DBW, and a NSERC USRA

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 850

Humans are more confident for items they have fixated before

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Emma E.M. Stewart[1] (emma.e.m.stewart@gmail.com), Casimir Ludwig[2], Alexander C. Schütz[1]; [1]University of Marburg, Germany, [2]University of Bristol, United Kingdom

Humans execute multiple saccades every second to sample information from the environment, creating complex scanpaths across many objects and locations. There is divergent evidence as to whether humans are aware of the locations and objects they have fixated across these sequences of saccades. While previous research explicitly asked participants to report the locations or objects of their fixations, we approached the problem from a different perspective by measuring perceptual confidence, to gauge instead whether people know how much information they have about objects in the world. If people retain a representation of how much information they have acquired about objects across fixations, there should be a link between fixations, perceptual confidence and perceptual performance. Participants viewed an array of five real-world, everyday objects that were presented at any random angle from 360º of possible viewpoints. After 1500ms, participants were asked to choose two objects to make a perceptual report on: this choice was a proxy measure for perceptual confidence. They then made a perceptual report by rotating a presented object to match the viewpoint they remembered. This report object could be chosen or non-chosen, with a higher probability of presenting a chosen object. Participants were more likely to choose objects they had fixated, and they reported the orientation of these objects more accurately. This demonstrates they had more perceptual confidence for items they had more precise information about. We also calculated information uptake for chosen vs non-chosen items, assuming a Gaussian window of information uptake around fixations; participants relied primarily on foveal vision, using a window with 1.6 degrees SD to guide choices. Overall this study suggests that humans retain an accurate representation about the precision of information gained during fixations. Knowing how much information you have about objects in the world may be more useful than remembering exact scanpaths.

Acknowledgements: This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 676786).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thanks for stopping by my virtual poster!

For any questions, please email me: emma.e.m.stewart@gmail.com

Follow me on Twitter: @eemstewart

Abstract ID: 246

Syntactic expectations modulate parafoveal processing of morphology on the word n+1 and word n in silent reading: evidence from a gaze-contingent boundary change manipulation

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Anastasia Stoops[1] (astoops414@gmail.com), Kiel Christianson[1]; [1]University of Illinois at Urbana-Champaign

Morphosyntactic information does not seem to modulate parafoveal processing in linear inflectional morphology languages (English (Kambe, 2004), Finnish (Bertram, 2003), Malay (Winskel et al., 2014)). To adjudicate between serial and parallel accounts (EZ-Reader (Reichle et al., 2009) vs SWIFT (Engbert et al., 2005)), such studies report only early first-pass measures: first-fixation (FF), single-fixation (SF) and gaze-duration (GD). Stoops et al., (2017; 2019) found early and late morphological effects on words n+1 and n, using boundary-change techniques (Rayner, 1975) in Russian, another linear-morphology language. The preview cost for morphologically-related versus identical and nonword previews was observed in total time (TT) for word n+1 and across early and late measures on pre- and post-boundary and whole-word regions in the word n, supporting the idea of increased attention span for word n (Juhasz et al., 2009). Importantly, the syntactic context of the target word was relatively unrestricted: morphologically-related preview was the most expected syntactic continuation according to a Cloze test (78%). The present study examined if the syntactic predictability modulated parafoveal processing of morphosyntactic information in Russian on the word n and word n+1 by reversing syntactic expectations for the preview. In the two experiments, the identical preview has the expected case marker (94% Cloze test score) and the morphologically-related preview has a syntactically unacceptable case inflection – second subject. Morphologically-related preview on word n+1 didn't differ from identical and induced preview benefit versus nonword in TT, suggesting word-level facilitation but no early message-level morphological preprocessing. Word n manipulation yielded preview benefit for identical and related versus nonword previews at post-boundary SF and

preview cost versus identical but no difference from nonword at whole-word TT. Results support word-level facilitation without message-level integration of syntactically unacceptable morphology. More cross-linguistic investigations are needed to understand the role of syntactic predictability on parafoveal processing in reading.

Acknowledgements: This research was supported by National Science Foundation [grant number BCS-0847533] to Kiel Christianson.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Corresponding author - Anastasia Stoops (agusico2@illinois.edu)

Abstract ID: 120

Talking about what we see, again: further evidence for non-anticipatory eye movements in dynamic scenes during sentence comprehension

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Roberto G. de Almeida[1] (roberto.dealmeida@concordia.ca), Caitlyn Antal[1], Julia Di Nardo[1]; [1]Concordia University, Montreal

We present two experiments involving true scenes (motion pictures of events), manipulating verb class, sentence semantic context, and scene motion context. Experiment 1 constituted a replication of [reference omitted, 2019]. Participants (N=32) were presented with sentences containing either a causative or a perception/psychological (experiencer) verb (e.g., Before making the desert, the cook will crack/examine the eggs that are in the bowl). Scene context varied according to the action performed by the agent (cook), moving towards the target object (eggs), away from it, or remaining neutral. Results were similar to those obtained by our previous study: a main effect of motion and no main effect of verb type. We obtained faster saccades to the target object in the causative sentences than in the experiencer sentences, but only in the towards motion condition. As in our previous study, we did not find anticipatory effects to target objects. In Experiment 2 (N=46), in addition to verb type (causative vs. experiencer) and agent motion (towards vs. neutral) we introduced a sentence context manipulation, with the first clause denoting either a semantically restrictive activity (e.g., In order to make the omelet...) or a non-restrictive one (e.g., After pouring the flour into the bowl,...). We predicted that the stronger context would enhance attention to properties of verbs making the potential referents of their objects more salient, thus driving anticipatory

effects found in other studies. We found an effect of motion and semantic context, with restrictive sentences driving faster saccades to target objects. We also found a verb effect with causatives yielding faster saccades than experiencer verbs only in the towards condition, but no anticipatory effects. These results suggest that early linguistic and visual processes are largely independent, interacting at a later, conceptual stage. We propose that the two systems interact using a common propositional code.

Acknowledgements: This work as supported by grants from NSERC and SSHRC

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The present study is a follow up of:
de Almeida, R. G., Di Nardo, J., Antal, C., & von Grunau, M. (2019). Understanding Events by Eye and Ear: Agent and Verb Drive Non-anticipatory Eye Movements in Dynamic Scenes. Frontiers in Psychology, 10:2162

For full details of the original study and the proposed model, see https://www.frontiersin.org/articles/10.3389/fpsyg.2019.02162/full#S11

Abstract ID: 986

The Contribution of Temporal Analysis of Pupillometry to Deciphering Cognitive Conflicts

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Ronen Hershman[1] (ronenhe@post.bgu.ac.il), Avishai Henik; [1]Ben-Gurion University of the Negev

Reaction time (RT) is one of the most frequently used measures to detect cognitive processes. When tasks require more cognitive processes / resources, reaction is slower. However, RTs cannot provide information about the temporal sequence (or existence) of cognitive processes. For this, a temporal index is needed. Pupils respond reflexively to light but also to cognitive activation. The more cognitive resources a task requires, the more pupil dilation that can be observed. However, despite being able to use changes in pupil size as a temporal measure (advanced devices measure changes in pupil diameter with sampling rate of above 1,000 samples per second), most past studies using pupil dilation have not investigated temporal changes. This led us, by using advanced statistical methods, to develop a novel analysis approach that provides detection as well as temporal characterization of cognitive processes. Our analysis detects differences in pupil size caused by different conditions and based on the time frames of the differences, can

determine the location of a cognitive process in time. In a series of studies we have shown, by measuring changes in pupil size, evidence for increment and regulation of emotional processes, and the development of cognitive conflicts in cognitive control tasks.

Acknowledgements: This work was supported by the Israel Ministry of Sciences and Technology

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 669

The effects of familiarisation on information sampling and task performance

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Andrew Webb[1] (andrew.webb@glasgow.ac.uk), Sara Spotorno[2], Philippe Schyns[1]; [1]University of Glasgow, [2]Keele University

Performing a specific task in a real-world environment necessarily means selectively sampling and using only a small subset of the information available in the scene. An interesting question is how the selectivity of that sampling is affected by familiarity, both with the environment and with the task itself. To address this question we designed an experiment in which participants performed one of two complex everyday tasks (using either a microwave or a coffee machine), in a real-world environment (a mock-kitchen) populated with a combination of task-relevant and task-irrelevant (distractor) objects (see Supplementary Figures). Participants were either familiar with both the environment and the correct equipment for their task (the familiar condition), familiar with the environment and the equipment for the other task (the switched condition), or familiar with neither (the control condition). While participants performed these tasks, we tracked both their gaze patterns and their positions in the environment. Analyses show that, as expected, familiar participants performed the tasks significantly faster than participants in the switched condition. Rather surprisingly, however, participants in the switched condition were also slower than those in the control condition, suggesting the possibility that familiarising to the requirements of another task interfered with their actual task. Familiar participants spent less time fixating both relevant and irrelevant objects compared to the control condition, whilst switched participants spent less time fixating irrelevant objects than control participants, but more time fixating relevant objects. This difference is mostly due to a

small number of task-critical sub-object regions. In sum, we show selectivity of information use for behavior (in terms of gaze patterns) following familiarisation in a real-world task, which will enable transfer to Virtual Reality of real-time availability of task-relevant information and control of interfering task-irrelevant information.

Acknowledgements: Jointly funded by Engineering and Physical Sciences Research Council (EPSRC) and the Ministry of Defence as part of Multidisciplinary University Research Initiative (MURI)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1775

Trail Making Test revisited: Patterns of visual and manual trajectories as markers of executive processes

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Juan Esteban Kamienkowski[1,2] (jkamienk@gmail.com), Ignacio Linari[1], Gustavo Juantorena[1], Agustín Petroni[1]; [1]Laboratorio de Inteligencia Artificial Aplicada, Instituto de Ciencias de la Computación (Universidad de Buenos Aires - CONICET) (Argentina), [2]Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires (Argentina)

The Trail Making Test (TMT) is a neuropsychological test widely used for decades for the diagnosis of executive dysfunctions in a set of neurological and psychiatric conditions. Briefly, the TMT has two parts: A) participants have to connect 20 consecutive numbers and B) both numbers and letters are connected in an alternate order (1-A-2-B, etc). It is a complex task involving different stages, like visual search, planning, monitoring the hand movements, and so on. These stages are also supported by distinct executive functions. Surprisingly, it is done with paper and pencil, and only the total time is quantified, resulting in a huge variability and unspecificity. In the present study, we designed a computer version of the TMT in order to study in more detail the components of the task, where we measured both hand and gaze position with high resolution in healthy participants, providing a deeper understanding of the underlying processes involved in performing a traditional test. Moreover, this task results in a very rich scenario to study the organization and architecture of cognitive processes involved in complex behavior. Firstly, we found that total time (part B vs A) was similar to the traditional version. Secondly, regarding eye movements, saccade and fixation durations were similar in A and B, but fewer fixations were needed to complete part A. Thirdly,

we found a longer lag between gaze and hand in B, explained by a delay in the outgoing hand movements but not in the gaze. Fourthly, these differences were correlated with a standardized evaluation of executive functions, in order to validate the digital TMT measures. Using both hand and eye movements we are able to parse the whole task into different stages, opening the possibility of exploring them in terms of different executive functions.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

If you have any questions, suggestions or comments, please drop me an email! (juank@dc.uba.ar; jkamienk@gmail.com)
If you are interested in my research, you can also check: Bianchi et al., Care et al., and Bujía et al. posters @V-VSS 2020...
or check:
http://liaa.dc.uba.ar/
https://www.researchgate.net/profile/Juan_Kamienkowski/research
https://scholar.google.com/citations?user=KqoUj1AAAAAJ&hl=es

Abstract ID: 931

Visual narrative viewers' event models have greater effects on their attention in Slideshows than Films

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Prasanth P Chandran[1] (prasanthp@ksu.edu), John P Hutson[2], Tim J Smith[3], Joe M Magliano[3], Lester C Loschky[3]; [1]Doctoral student, [2]Postdoctoral fellow, [3]Professor

Viewers' attention in film is strongly driven by stimulus features (e.g., motion), while comprehension processes (e.g., the viewer's event model), have relatively minimal influence, which we call the "Tyranny of Film". Conversely, in picture stories, viewers' event models have a larger impact on attentional selection. Thus, does removing motion, but maintaining the other filmic features (e.g., shot composition), attenuate the "Tyranny of Film", thereby increasing the influence of comprehension processes on visual selective attention? Or, is removing motion insufficient to allow viewers' event models to guide attentional selection? This study used the opening scene of "Touch of Evil". The scene shows a time-bomb put in a car, a couple unknowingly gets in the car and drives away, and the scene ends just before the bomb explodes.

Previous work using this clip showed few effects of viewers' event models on attention--supporting the "Tyranny of Film". This eye-tracking study removed motion by presenting the narrative as a slideshow of single frames from the film, while maintaining the narrative content and viewing duration. Context participants watched the full slideshow. No-context participants didn't see the bomb or the couple in the car, instead started later when another couple was shown walking down the street. At the end of the slideshow, we asked participants to predict what would happen next. Context participants were more likely to infer the bomb would explode, showing a critical difference in their event models. Critically, Context participants were more likely to fixate the car throughout the shared viewing period, breaking the "Tyranny of Film". Nevertheless, there were no significant effects of inference generation on this effect. Thus, the Context participants' greater looks at the car were likely due to treating the couple in the car as protagonists/agents, rather than maintaining the bomb in their event models.

Acknowledgements: Funding: National Science Foundation Grant 1348857 to LL.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for visiting our poster.

To interact with us, we welcome you to attend one of our three scheduled presenter conferences or using the chat section. You can also direct your queries and feedback to my email ID: prasanthp@ksu.edu.
We would love to hear from you.

If you are further interested in our research then, Please sign-up for our upcoming Journal at this Sign-up sheet (https://docs.google.com/spreadsheets/d/1MOM70-p7evWEdfZO8hd68-89J5F0ykrX9Yp4p8lJ1H4/edit?usp=sharing).

Abstract ID: 1564

What affects fixations during image viewing? Working memory load, saliency, and ADHD-like traits

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Astrid Priscilla Martinez Cedillo[1] (a.p.martinezcedillo@essex.ac.uk), Kevin Dent[1], Tom Foulsham[1];
[1]University of Essex, United Kingdom

Load theory of selective attention argues that high cognitive load impedes distractor avoidance (see, Lavie, 2005). We report three experiments investigating the effect of working memory (WM) load on selective attention. In our first behavioural study, we successfully replicated two experiments showing that higher WM load increases the effects of distractors in a flanker or singleton paradigm (Lavie et al 2004; Lavie & De Fockert, 2005). Considering these results, we then investigated visual attention during the viewing of complex scenes (featuring social and non-social objects), while manipulating WM load. We also explored the relationship between these tasks and ADHD-like traits, given that these traits are associated with increased distraction. In the image viewing task, we measured the degree to which fixations targeted each of two crucial elements: (1) a social element (a person in the scene) and (2) a non-social object which was edited to be high or low saliency. We tested the hypothesis that high WM load would lead to increased capture by the salient distractor. In contrast, attending to the social item might require more top-down resources and so be disrupted by WM load. Our results suggest that during image viewing the social object was fixated to a greater degree than the other object (regardless of saliency). While, there was a relationship between the degree of ADHD-like traits and performance on the memory task, WM load did not seem to affect scanning in scenes. Such findings suggest that attending to a social area in complex stimuli is surprisingly not dependent on the availability of top-down resources.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 670

What is the Center in the Center-Bias?

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Ohad Ben-Shahar[1,2] (ben-shahar@cs.bgu.ac.il), Rotem Meiron[1,2]; [1]Ben Gurion University of the Negev, [2]Zlotowski center for Neuroscience at BGU

Since early gaze-tracking experiments, a wealth of studies have sought to estimate where people look in natural images. Typically, the data for these studies come from free-viewing experiments that share similar settings. A consistent finding in these studies is that eye-fixations fall more often at or near the center of the image than its periphery. Multiple reasons have been examined for contributing to this center-bias, including the image position on the screen and feature biases in the dataset images. However, the stimuli in these studies encapsulate multiple types of centers, all of which coincide at the same spatial location and therefore are indisciminable. The reason for this is that virtually always the stimuli are perceptually framed very simplistically, namely within a rectangle. In order to determine which of these different types of

centers is responsible for the center-bias, we manipulate the boundaries of the stimuli into different shapes, including non-convex and/or asymmetric polygons. This allows us to specify different types of centers (and in particular, the center of the convex-hull, the center of the bounding-box, the center of mass, and the visual center) and systematically estimate the tendency towards each of them. Our analysis unveils the influence of stimulus boundaries on the center-bias and suggests that the center of mass of the stimulus is the one that facilitates the content-independent center-bias. This finding also supports the hypothesis that observers tend to fixate more often at the center of mass of visual objects.

Acknowledgements: We acknowledge the support of the Frankel center for Computer Science research at BGU.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1733

What's salient in a graphic design anyway?

Poster Presentation - *Topic area: Eye Movements: Cognition and complex stimuli*

Zoya Bylinskii[1], Camilo Fosco[2], Vincent Casser[2], Amish Kumar Bedi[1], Aaron Hertzmann[1]; [1]Adobe Inc., [2]CSAIL, MIT

Movie posters, social graphics, and product advertisements are designed to capture the viewer's attention and efficiently redirect it to relevant information. For natural images, computational models of saliency have been successful at predicting where the average observer is likely to look. However, such models have been lacking for graphic designs. Knowing what holds an observer's attention for a longer period, rather than what pops out in a bottom-up manner, is more relevant for graphic designs, which are composed of image and text elements. Analogous to saliency, we define an 'importance map' as a heatmap providing a real value at each image pixel indicating the probability that observers would find that image region important. In contrast to saliency, instead of collecting ground truth data using an eye tracker, we ask human participants to annotate regions of graphic designs they think are important (using methodology from O'Donovan 2014). Averaging the annotations of 25-30 observers generates smooth, ground truth importance maps. We collected importance maps for 1000 designs across 5 different classes: webpages, movie posters, mobile UIs, infographics, and advertisements, and present this as the Imp1k dataset. We also introduce a computational model of importance for graphic designs, trained using Imp1k. Our model is a deep neural network that can simultaneously predict the class of a graphic design with 95% accuracy, and can predict the importance maps with a Pearson's Cross Correlation of 0.827 (KL score of 0.159) compared to ground truth. We extend our model by training it with natural images as a 6th class, and demonstrate that the same model can be used to predict saliency maps on natural images and importance maps on graphic designs. Finally, we show how our Unified Model of Saliency and Importance (UMSI), can be used to generate automated suggestions within interactive design applications.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 414

Eye Movements: Fixation

Active task-dependent control of ocular drift during natural fixation

Poster Presentation - *Topic area: Eye Movements: Fixation*

Janis Intoy[1,2,3] (jintoy@bu.edu), Jonathan D. Victor[4], Michele Rucci[2,3]; [1]Graduate Program for Neuroscience, Boston University, [2]Brain & Cognitive Sciences, University of Rochester, [3]Center for Visual Science, University of Rochester, [4]Brain and Mind Research Institute, Weill Cornell Medical College

The human eyes are never at rest. In the so-called "fixation" periods in between saccades, the eyes wander incessantly following seemingly erratic trajectories, a motion known as ocular drift. These movements shift the image on the retina across many receptors, yielding temporal modulations that enhance high spatial frequencies. Consistent with this effect, previous studies have shown that ocular drift is beneficial for high-acuity vision. Ocular drift is widely believed to be an involuntary, random motion, presumably resulting from physiological limits in oculomotor precision. However, theoretical considerations indicate that changes in drift characteristics would be beneficial to emphasize different ranges of spatial frequencies. Do humans actively modulate their eye drifts depending on the visual task? Here we compared the characteristics of eye drifts measured during free viewing of natural images (n=28), examination of faces (n=22), reading (n=13), testing of visual acuity (n=15), and sustained fixation on a marker (n=29). Eye movements were recorded by means of a high-resolution DPI eye tracker. We report considerable changes in drift characteristics across tasks. In all cases, Brownian Motion (BM), a specific case of a random walk

that well describes the motion of a particle in a fluid, proved to be a good model of ocular drift. However, the diffusion constants of motion differed significantly across tasks and were considerably smaller in the tasks that required fine spatial discriminations. Furthermore, whereas BM provided an excellent fit in high-acuity tasks, small deviations from BM were evident in other tasks, where ocular drift was better modeled by fractional Brownian Motion (fBM) with a Hurst index larger than unity. These results are consistent with predictions based on the frequency content of the luminance modulations delivered to the retina in the various tasks. They show that humans actively tune ocular drift according to the task at hand.

Acknowledgements: Research Supported by NIH F31 EY02956, R01 EY18363, and R01 EY07977

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for visiting our poster! I am hosting several video conferences throughout the week to answer any questions and discuss this project further.

Or, contact me via e-mail (jintoy[at]bu[dot].edu) or on twitter (@janisirene)! Visit janisintoy.com to learn more about me and my research interests.

Abstract ID: 1335

Eye on the prize: Fixational stability as a metric for the recovery of visual acuity in amblyopia

Poster Presentation - *Topic area: Eye Movements: Fixation*

Avi Aizenman[1] (avigael_aizenman@berkeley.edu), Dennis Levi[1]; [1]UC Berkeley

Amblyopia is a developmental disorder which leads to impaired form vision and oculomotor abnormalities including eccentric and unsteady fixation. Increased fixational unsteadiness is associated with poor visual acuity and stereopsis. In this study, we investigated whether improvements in visual function with treatment are accompanied by changes in fixational stability, i.e., whether changes in fixation stability can serve as an objective proxy for changes in visual acuity in children undergoing treatment for amblyopia. Five children with amblyopia currently undergoing patching treatment or vision therapy (3 strabismic, 2 anisometropic, mean age 8.2 years) and five normally sighted children (control group, mean age 9.4 years) participated in 3 sessions over 3 months. During each session, we measured visual acuity and stereopsis. To

measure fixational stability, observers were asked to look at a 1-degree colorful smiley face on a black screen for 20-second intervals. To ensure attention, the smiley face changed color after 10 (+/-3) seconds and observers responded when the color changed. There were ten 20 second trials in total. Eye movements were recorded with an Eyelink II eyetracker. We calculated the 68% isoline area (ISOA) values (similar to the more common bivariate contour ellipse metric, but without assumptions of normality) as a measure of fixational stability, and computed correlations between clinical measurements and ISOA. ISOA showed a correlation with visual acuity (r-squared=.41), and stereopsis (r-squared=.46) replicating previous work. Importantly, the change (pre/post ratio) in ISOA showed a correlation with changes in visual acuity (r-squared=.59), but not stereopsis (r-squared=.02). Although stereopsis is correlated with fixational stability by session, the changes in fixational stability during the treatment of amblyopia do not track changes in stereopsis. As improvements in visual acuity are accompanied by changes in fixational stability, novel interventions for amblyopia may consider tracking eye movements as a measure of recovery of visual function.

Acknowledgements: This work was funded by the Berkeley Fellowship to AMA and by grant RO1EY020976 from the National Eye Institute (to DML).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

Thank you so much for virtually stopping by my poster!

I would love to chat more about this project. Please don't hesitate to reach out with any questions/comments or to schedule a time to chat!

email: avi.aizenman@berkeley.edu

Abstract ID: 558

Fixation characteristics with Central Vision Loss at different gaze postures in a CSF task

Poster Presentation - *Topic area: Eye Movements: Fixation*

Tiffany Arango[1] (arango.t@husky.neu.edu), Nicole C. Ross[2], Peter J. Bex[1]; [1]Northeastern University, [2]New England College of Optometry

Patients with central vision loss adopt an eccentric preferred retinal locus (PRL) in the absence of functioning foveae. Early work examined PRL selection under monocular viewing in primary gaze, and recommends patients adopt one PRL in the inferior visual field to optimize visual function. Less is known about PRL use during binocular gaze at different gaze postures. We examined fixation behavior under binocular and monocular viewing, in 9 different gaze positions, while observers completed a contrast sensitivity task. Subjects were recruited with bilateral central scotomas (n=7) defined with a MAIA microperimeter who have not received fixation training. Subjects completed a 9 point fixation task (8X8 degree grid) in binocular and monocular viewing conditions. Fixation stability (68% BCEA) was calculated for each eye at each location. A contrast sensitivity task was then completed in the gaze postures with highest and lowest fixation stability. Subjects identified band-pass filtered letters, whose spatial frequency and contrast were controlled with a quick CSF algorithm (Hou et al, 2017). Binocular eye movements were tracked using the Eyelink eye tracker, through a neutral density filter for monocular conditions. The fixation distance from the target center and estimated gaze center was calculated for each condition. PRL changes were estimated from differences among these distributions with one- and two-sample t tests. Under binocular viewing conditions, fixation stability was associated with higher accuracy in the CSF task in the more ($p=.05$) but not the less ($p=.85$) stable fixation location. Fixation stability was not associated with accuracy in the CSF task in either monocular viewing condition ($p>.05$). PRL location significantly differed in most gaze postures (Bonferroni corrected, p's $< .001$) for binocular and monocular conditions. Results demonstrate PRLs are highly dependent on the conditions used to measure them, and this malleability suggests that they may be amenable to rehabilitation training.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for your interest in our poster!

Abstract ID: 1574

Fixational Eye movements Act More Globally When Seeing Locally: A Motion-Integration Perspective

Poster Presentation - *Topic area: Eye Movements: Fixation*

Yujie Wu[1] (yujiewu@mail.bnu.edu.cn), Mei Qiu[1], Dajun Xing[1]; [1]Beijing Normal University

Fixational eye movements are assumed to be linked to visual perception. However, an increasing number of studies show dissociations between human perception and eye movements. Here we examined whether

involuntary fixational eye movements, including microsaccades and intersaccadic drift, behave consistently with our perception when human and monkeys watch visual stimuli that elicit either coherent motion perception or incoherent motion perception. We recorded eye movements of human and monkeys in a fixation task while showing them three different motion patterns: pattern 1 is a diamond frame (8 degree for size, 0.5 degree for line width) rotating around a fixation point; pattern 2 is the same rotating frame with its corners covered by four black static occluders (0.1 cd/m2 for luminance, 4 degree for each occluder size); pattern 3 is a rotating frame also same as pattern 1 with its corners covered by four static occluders whose luminance are the same as background luminance (37.9 cd/m2). All human participants perceived motion pattern 1 and 2 as coherent motion, and perceived pattern 3 as incoherent motion (four line segments moving in two orthogonal trajectories). However, under all three conditions, participants showed similar circular traces of fixational eye movements which were consistent with circular trajectories of global motion. Similar to human participants, 4 monkeys showed circular eye movement traces for all three motion patterns. Furthermore, we found both directions of microsaccades and drift velocity showed periodic circular patterns consistent with global motion under three conditions. Our findings suggest that both microsaccades and drift in fixational eye movements reflect motion information in a global manner without awareness, which leads to a dissociation between fixational eye movements and perception in a motion-integration perspective.

Acknowledgements: This work was supported by National Key Basic Research Program of China 2014CB846100 and 2014CB846101, National Natural Science Foundation of China Grant (31371110), and the BNU Interdisciplinary Research Foundation for the First-Year Doctoral Candidates (BNUXKJC1909).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 717

Microsaccades around the visual field

Poster Presentation - *Topic area: Eye Movements: Fixation*

Simran Purokayastha[1] (sp4019@nyu.edu), Mariel Roberts[1], Marisa Carrasco[1]; [1]New York University

[Goal] Visual performance fields (PFs) are characterized by two asymmetries: Performance is better along the horizontal than vertical meridian (Horizontal-Vertical Anisotropy) and along the lower than upper vertical meridian (Vertical Meridian (VM) Asymmetry). Here, we investigated how the directionality of microsaccades (MS, fixational eye movements <1°) vary during a visual discrimination task with stimuli placed along the cardinal meridia, for which discriminability varies (Experiment 1) or is equated across all locations (Experiment 2). [Methods] Observers performed a 2AFC orientation-discrimination task, which depends on contrast sensitivity, while maintaining fixation. On every trial, 4 Gabors briefly appeared simultaneously at 4 cardinal, isoeccentric (6.4°) locations. Shortly thereafter, a response cue indicated the target. In Experiment 1, contrast was fixed across locations. In Experiment 2, we equated task performance across all locations using different contrast thresholds per location. Eye fixation was monitored with an eye-tracker. Microsaccades were detected with a standard velocity-based detection algorithm (Engbert & Kliegl, 2003). [Results] We found typical PFs in the discrimination task for Experiment 1, and same discrimination across locations (by design) in Experiment 2. However, MS patterns were similar in both experiments. From trial- to response- cue onset, MS were more frequent toward the horizontal and upper-vertical locations than the lower-vertical location. But immediately after response cue onset, observers made more MS toward the target meridia; i.e. horizontal (vertical) bias when targets were on the horizontal (vertical) meridian, and more MS toward the upper- than lower- VM. [Conclusions] MS-direction follow the same pattern regardless of whether discriminability differs or is similar across isoeccentric locations. Interestingly, when stimuli are placed along the cardinal meridia, there is no overall MS horizontal bias. Once observers know the target location, MS are biased along the corresponding meridia, and in particular to the location where discriminability is typically lowest (upper-VM).

Acknowledgements: NIH NEI R01-EY027401

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1524

Microvergence eye movements during fixation

Poster Presentation - *Topic area: Eye Movements: Fixation*

Daria Ivanchenko[1] (dasha.ivanchenko@me.com), Katharina Rifai[2], Ziad M. Hafed[3], Frank Schaeffel[3]; [1]M.Sc., [2]Dr., [3]Prof. Dr.

Even during stable fixation, our eyes make tiny movements called fixational eye movements. In a large fraction of studies, such eye movements were measured in only one eye at a time. While a great deal can still be learned about the impacts of fixational eye movements on visual performance using monocular tracking, such tracking does not aid in understanding additional important mechanisms regarding the

integration of visual information from the two eyes. In this study, we used a custom-built video eye tracker to study intraocular correlations of slow fixational drifts. We found that during sustained fixation, the eyes can sometimes drift in opposite directions, particularly along the horizontal dimension. Since these movements are similar to those during convergent eye movements but with much smaller amplitudes, they may be referred to as “microvergence”, in analogy to the commonly used term “microsaccades” for small saccades. Vertical eye positions in the two eyes were more positively correlated, again supporting the notion that the opposite motions in the horizontal direction were related to vergence eye movements. Interestingly, microvergence eye movements were generated independently of visual input: when one or both eyes were covered by infrared transmitting filter(s) that precluded vision in the covered eye(s) but still permitted eye tracking, the spatial-temporal patterns of microvergence eye movements remained similar to when both eyes were uncovered. This suggests that microvergence can be generated by the oculomotor system without the need for visual stimuli. We hypothesize that a possible function of microvergence could be to modulate the statistics of binocular disparities.

Acknowledgements: This study was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), project number 276693517, SFB 1233, project TP11.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1295

Rapid stimulus-driven modulation of slow fixational drift eye movements

Poster Presentation - *Topic area: Eye Movements: Fixation*

Tatiana Malevich[1] (tatiana.malevich@cin.uni-tuebingen.de), Antimo Buonocore[1], Ziad M. Hafed[1]; [1]Werner Reichardt Centre for Integrative Neuroscience

Stimulus onsets affect microsaccades, but whether slow fixational eye position drifts, normally considered random processes, are also transiently affected is unknown. We recorded eye movements of three rhesus monkeys using scleral search coils, and we analyzed microsaccade-free fixation after visual transients. In a first condition, each monkey fixated a white spot over a gray background. At a random time, the display changed: one entire half (right or left) became black; a half-circle of 0.74-deg radius around the fixated position remained gray, in order to maintain view of the stable fixation spot. The entire gray-and-dark

stimulus (centered on gaze position) was presented gaze-contingently, using retinal image stabilization, in order to maintain the “split” view condition for 500-3000 ms. In trials without microsaccades (-100 to 200-350 ms from transient onset), a short-latency drift response occurred at ~50 ms and lasted for ~100 ms. It consisted of an upward velocity pulse (peak speed ~0.5 deg/s) whose horizontal component was also biased by the side of darkness: the upward drift tilted rightward when the darkness was on the right of gaze and leftward when it was on the left. In a control condition (no “split” view stimulus), there was no drift pulse. We then tested two monkeys when a single-frame (~8 ms) white or black full-screen flash occurred. We observed the same upward drift, with a marginally higher peak velocity for the dark flash compared to the white flash. Small localized flashes (1x1 deg squares at 2.1 deg eccentricity either right or left of fixation) were significantly less effective in modulating drift. Our results show that both persistent and transient luminance changes, particularly when they cover relatively big regions, robustly affect fixational eye positions. We hypothesize that upward drifts might reflect impacts of potential overrepresentation of the upper visual field in visual-motor oculomotor structures.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1322

The visual field location of phosphenes induced by transcranial magnetic stimulation (TMS) is precisely mapped to eye position

Poster Presentation - *Topic area: Eye Movements: Fixation*

Katelyn Tsang[1], Javeria Hasan[2], Andrew Silva[3], Benjamin Thompson[4]; [1]University of Waterloo

Cortical prostheses for vision restoration produce phosphenes by electrically stimulating groups of V1 neurons. The phosphenes are oculocentric; their perceived position is relative to the point of fixation. The aim of this study was to explore the fidelity of the mapping between the perceived location of electrically induced phosphenes and eye position. Phosphenes were induced using triple-pulse transcranial magnetic stimulation (TMS) of the primary visual cortex and eye position was monitored using an infrared gaze tracker. Nine participants were cued to fixate randomly selected locations within a 38.5º X 19.2º grid while keeping head position constant and indicated the perceived location of a TMS-induced phosphene using a computer mouse. A central fixation point was presented 8 times while all other fixation points (n = 35) were presented 3 times. The sequence of fixation locations was randomized. The TMS site was determined individually for each participant as the location eliciting a reliable central phosphene at the lowest

stimulation intensity. The TMS stimulation site was held constant throughout the experiment using a BrainSight neuronavigation system. We observed a precise mapping between reported phosphene location and fixation location for all 35 grid locations in all nine participants (global mean distance of phosphene from fixation = 1.0º, SD across all fixation locations = 0.2º). No significant difference in phosphene location was found between the central and peripheral fixation locations, $t(8) = 1.7$, $p = .13$. Our results are consistent with prior studies involving visual prostheses and illustrate the oculocentric mapping of primary visual cortex. In addition, our results indicate that control of fixation is paramount in phosphene-related research.

Acknowledgements: NSERC Grants RPIN-05394, RGPAS-477166

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 410

Triggering microsaccades by foveal motor error is sufficient to modulate peripheral visual sensitivity: neural and perceptual evidence

Poster Presentation - *Topic area: Eye Movements: Fixation*

Tong Zhang[1] (zhangtongdora@hotmail.com), Xiaoguang Tian[1], Ziad Hafed[1]; [1]Werner Reichardt Centre for Integrative Neuroscience

Visual processing is frequently interspersed with saccades, which are associated with strong peri-movement changes in neural and perceptual sensitivity. With fixed gaze, for controlled experiments on processes like covert attention, microsaccades still occur. During the past two decades, it became clear that microsaccades are not random (Hafed and Clark, 2002; Engbert and Kliegl, 2003), but instead exhibit predictable correlations with enhanced or decreased peripheral visual sensitivity (in multiple brain areas) and perception. These time-locked changes appear at eccentricities 1-2 orders of magnitude larger than the eye movement endpoints themselves. However, it remains unclear whether it is microsaccades, perhaps through their motor preparatory activity, that causally influence visual sensitivity, or whether visual sensitivity is itself modulated independently of microsaccades, maybe through oscillatory brain-state fluctuations; in this case, it is such modulations that “leak” into the motor system and trigger microsaccades. Here, motivated by (Hafed and Clark, 2002), in which no attentional effects were present in

the absence of microsaccades, we tested the former hypothesis. We used real-time retinal image stabilization to introduce foveal motor errors at fixation (~0.06 deg) and causally drive microsaccades in an experimentally-controlled direction. We then presented peripheral (>5 deg) visual stimuli congruent or incongruent with microsaccade direction and recorded monkey superior colliculus (SC) activity. We found enhanced visual sensitivity and faster reaction times for microsaccade-congruent stimuli as a result of causally-generated microsaccades. In humans, we adapted a known task for pre-saccadic perceptual sensitivity (Rolfs & Carrasco, 2012) for microsaccades: subjects fixated, and we shifted the fixation spot by ~0.18 deg right or left to trigger microsaccades; the actual perceptual task (contrast comparison) was done for stimuli at 7 deg. Peripheral contrast sensitivity was enhanced before experimentally-manipulated microsaccades congruent with stimulus location, consistent with the neurophysiological results. Thus, foveal motor activity is sufficient to influence peripheral visual sensitivity.

Acknowledgements: We were funded by the Werner Reichardt Centre for Integrative Neuroscience, an excellence cluster funded by the DFG (EXC307).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1246

Eye Movements: Measurement, models and mechanisms

Analyzing task-specific patterns in human scanpaths

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Matthias Kümmerer[1] (matthias.kuemmerer@bethgelab.org), Thomas S.A. Wallis[1,2], Matthias Bethge[1]; [1]University of Tübingen, [2]Amazon Research Tübingen (this work was done prior to joining Amazon)

Humans gather high-resolution visual information only in the fovea, therefore they must make eye movements to explore the visual world. The spatio-temporal fixation patterns (scanpaths) of observers carry information about which aspects of the environment are currently relevant. Most of the recent progress on predicting the spatial and spatio-temporal patterns of human scanpaths has been focused on free-viewing conditions. However, fixations and scanpaths are known to be strongly influenced by the task

performed by observers. The purpose of this work is to analyze those influences in a quantitative way. The DeepGaze III model for scanpath prediction (Kümmerer et al, VSS 2017) has been shown to achieve high performance in predicting free-viewing scanpaths. DeepGaze III extracts features from the VGG deep neural network that are used in a readout network to predict a saliency map, which is then processed in a second readout network together with information on the scanpath history to predict upcoming saccade landing positions. Here, we train different task-specific versions of DeepGaze III on human scanpath data of subjects performing different tasks on the same images (freeviewing, objectsearch, saliencysearch; Koehler et al., JoV 2014). Prediction performances show that the models successfully adapt to the task-specific scanpaths. We find and visualize cases where the model predictions differ substantially for the different tasks. The task-specific models can be used to detect the task of a given scanpath via maximum-likelihood classification. We find that while purely spatial task-specific models (finetuned versions of DeepGaze II) perform above-chance (43%) at task recognition, changing to the scanpath-aware DeepGaze III models improves performance further to 45%. This quantifies spatial and temporal contributions to task-specific differences in human scanpaths. In the future, we plan to extend our analysis towards quantifying differences in the way scene content and scanpath history interact in fixation selection in different tasks.

Acknowledgements: We acknowledge support from the German Federal Ministry of Education and Research (BMBF) through the Tübingen AI Center (FKZ: 01IS18039A) and from the German Science Foundation (DFG): SFB 1233, Robust Vision: Inference Principles and Neural Mechanisms, project number 276693517.

Presenter Conferences

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22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1191

Cortical microcircuitry encoding expected utility and reward prediction error for visually guided saccades

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Amirsaman Sajad[1] (amirsaman.sajad@vanderbilt.edu), Jeffrey D Schall[1]; [1]Vanderbilt University

Cognitive control requires evaluating the outcome of actions relative to expectations, then updating a model of the world when expectations are violated (i.e., prediction error). Medial frontal cortex (mFC) plays a key role in these functions and is a likely source for associated event-related scalp potentials. However, the microcircuitry is unknown. To address this, we sampled neurons across all layers of the supplementary eye field, an area in mFC involved in monitoring visually-guided eye movements. Neural discharges were recorded from two monkeys while performing the saccade stop-signal task. On most trials, monkeys were rewarded for looking at a peripheral visual stimulus, but occasionally a stop-signal instructed them to inhibit the gaze shift. Each direction was associated with low or high reward amounts and this association reversed unpredictably after ~20 rewarded trials. Thus, the first rewarded trial in each block was associated with the highest and the following trials with progressively lower reward prediction error (RPE). As expected, the response time (RT) of both monkeys showed sensitivity to reward amounts. Saccade RT to high-reward targets was significantly faster than that for low-reward targets. Upon block reversal, RT adaptation was observed with progressive reduction of RT to the high-reward target and elevation to the low-reward target. Negative RPE (i.e., lower than expected reward) was associated with a relative facilitation of neurons in layers 2 and 3 (L2/3) and suppression of neurons in L5/6. Neurons signaling higher than expected reward (positive RPE) exhibited a complementary laminar pattern with higher proportion of facilitated neurons in L5/6 and suppressed neurons in L2/3. These results reveal the laminar microcircuitry underlying value and prediction error encoding and complement our previous report of differential contributions of upper and lower layers to encoding negative and positive outcomes.

Acknowledgements: This work was supported by a CIHR Postdoctoral Fellowship and by R01-MH55806, R01-EY019882, P30-EY08126, and by Robin and Richard Patton through the E. Bronson Ingram Chair in Neuroscience.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 325

DeepMReye: MR-based eye tracking without eye tracking

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Matthias Nau[1,2] (matthias.nau@ntnu.no), Markus Frey[1,2], Christian F. Doeller[1,2]; [1]Kavli Institute for Systems Neuroscience, NTNU, Trondheim, Norway, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

In many fMRI studies, viewing behavior is a major variable of interest, or one of confound. Concurrent eye tracking is expensive, often time consuming to set up and imposes experimental constraints (e.g. the eyes need to be open). Here, we developed DeepMReye; a deep-learning-based framework to decode viewing behavior from the MR-signal of the eye balls (see Frey et al., VSS2020). We trained and tested the model on data of more than 250 participants acquired on six 3T-MRI scanners with a variety of scanning protocols. Participants performed diverse viewing tasks including fixation, guided saccades and smooth pursuit, visual search, free movie- and picture viewing as well as eye movements when the eyes were closed. Our model successfully recovers gaze position and associated variables such as direction and amplitude at sub-TR resolution during these tasks, without the need for eye tracking equipment. A confidence score obtained for each decoded sample further indicates the intrinsic model certainty. Critically, our model generalizes across participants, tasks and MR-scanners, suggesting that viewing behavior could be reconstructed post-hoc even in existing fMRI data sets. To test this, we explore the boundary conditions and generalizability across fMRI-scanning protocols by systematically varying voxel size and repetition time (TR) in a subset of participants with concurrent eye tracking. In sum, DeepMReye allows to decode viewing behavior post-hoc from fMRI data, which can be integrated into existing fMRI pipelines to study or account for gaze related brain activity.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
22 June, 8:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

Hi everyone,
Thanks for dropping by my poster!

If you have any questions, or if you cannot make it to any of scheduled presenter conferences, please reach out to me:
Email: matthias.nau@ntnu.no
Twitter: @NauMatt

Best wishes,
Matthias

Abstract ID: 1014

Different sources of predictions during natural reading: an EEG and Eye-Tracking co-registration study

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Bruno Bianchi[1] (brunobian@gmail.com), Rodrigo Loredo[2], Julia Carden[2], Virginia Jaichenco[2], Titus von der Malsburg[3], Diego Shalom[4], Juan Kamienkowski[1]; [1]Computer Science Department, University of Buenos Aires, Argentina, [2]Instituto de Linguística, University of Buenos Aires, Argentina, [3]Department of Linguistics, University of Potsdam, Germany, [4]Physics Department, University of Buenos Aires, Argentina

During reading our brain predicts upcoming words. If predictions are correct, words can be processed faster when they are finally fixated. It has been amply shown that Predictability (the variable that estimates the probability of guessing the next word) have an impact on how we move our eyes across the text and that it modulates brain potentials associated with word processing. On the one side, more predictable words are fixated for shorter periods of time than less predictable words. On the other side, more predictable words correspond to less N400 amplitude. This knowledge comes from separated EEG and eye movement experiments, but in the last few years, co-registration experiments enabled us to test these hypotheses together in more natural contexts. With the aim of investigating different sources of predictions during reading, in previous studies, we showed that mnemonic predictions (i.e. predictions performed purely on long term memory, like when reading a proverb or a song lyric) and predictions done purely on the linguistic context have different impact, both on gaze duration and on the N400. Here, we asked participants to read proverbs and common sentences while we recorded EEG and eye movements simultaneously. Firstly, we analysed brain activity aligned to fixation onset (fixation-related potential, FRPs) showing differences between Proverbs and Common sentences in late potentials evoked by low- and high-Predictable words. Secondly, we analysed oscillations aligned to fixation onset (fixation-related spectral perturbations, FRSPs) showing differences between sentence type only in low-frequency bands after 200ms. These results extend our knowledge of the differences between the mechanisms involved in the prediction of the following word.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Hi, thanks for coming! If you are interested in our study you can join to our zoom conferences or asking on the chat. For more information or quetions you can find us in:

My Email: brunobian@gmail.com
My twitter: @Sci_Brunobian
My ResearchGate profile: https://www.researchgate.net/profile/Bruno_Bianchi2

Our Website: https://reading.liaa.dc.uba.ar/

Abstract ID: 1308

Identification of the functional PRL for fine visual tasks

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Josselin Gautier[1] (jgautier@berkeley.edu), Norick Bowers[2], Martin Banks[3], Austin Roorda[4]; [1]University of California Berkeley

During fine visual tasks, eyes undergo complex fixational eye movements (FEM) comprised of drift and microsaccades. The peak of the distribution formed by the aggregate FEM is generally considered to be the preferred retinal locus (PRL). But, owing to the fact that vision is widely believed to be suppressed during microsaccades, the functional PRL (fPRL) may represent a smaller retinal region. Accurate identification of the fPRL is an important step in better understanding human foveal vision. We used high-speed, sub-arcmin, retinal-image-based eye tracking to measure the fPRL's exact location and distribution. The system is an Adaptive Optics Scanning Laser Ophthalmoscope with stimulus projection capabilities combined with custom software for offline tracking and image analysis. We devised a Vernier hyperacuity task that engaged natural FEM while allowing acuity to be measured during brief stimulus exposures and over few cones of the retina. Three subjects reported offsets between two 2x1 arcmin horizontal black bars separated by 1 arcmin along 7 steps of 12 arcsec. Duration was 34ms. Each stimulus was presented monocularly within a small square in the center of four black fixation guides. Stimuli were presented in a predictable cadence every 2 seconds, which ensured constant fixation strategy during the experiment. Over 2000 trials with different offsets were presented in pseudorandom order for each subject. The conventional PRL was compared to the fPRL (determined from only those epochs of FEM when the stimulus was present). Preliminary results reveal a systematic tendency to recenter gaze within +/-3arcmin (+/-5 cones). The fPRL location is more confined and slightly deviated from the conventional PRL. Consistent with previous observations during a tumbling-E letter acuity task, microsaccade initiation and landing positions tended to form two distinct clusters, with the fPRL located somewhere in-between. More analysis will be presented to uncover the functional significance of the PRL.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

if you have any questions, please don't hesitate to contact me at josselingautier[at]gmail.com

Abstract ID: 1406

Introducing the TurkEyes toolbox: UIs for crowdsourcing attention without an eye tracker

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Anelise Newman[1] (apnewman@mit.edu), Barry McNamara[1], Camilo Fosco[1], Yun Bin Zhang[2], Patr Sukhum[2], Matthew Tancik[3], Nam Wook Kim[4], Zoya Bylinskii[5]; [1]CSAIL, MIT, [2]Harvard, [3]University of California, Berkeley, [4]Boston College, [5]Adobe, Inc.

Eye movements provide insight into what parts of an image a viewer finds most salient, interesting, or relevant to the task at hand. Unfortunately, eye tracking data, a commonly-used proxy for attention, is difficult to collect at scale. Here, we present TurkEyes, a toolbox of crowdsourceable user interfaces to collect attention data without using an eye tracker. The four interfaces in our toolbox represent different interaction methodologies found in the literature for capturing attention. ZoomMaps (introduced here) is a "zoom-based" interface that tracks the viewport on a user's mobile phone while they pan and zoom. CodeCharts (inspired by Rudoy et al., 2012) is a "self-report" technique where participants specify where they gazed using a grid of codes that appears after image presentation. ImportAnnots (O'Donovan et al., 2014) is an "annotation" tool for selecting important image regions, and BubbleView (Kim et al., 2017) is a "cursor-based" moving-window approach that lets viewers click to reveal a small area of an otherwise blurred image. We place these interfaces within a common code and analysis framework to compare their output and develop guidelines for how to use them. We design experiments and validation procedures to capture high-quality data and explain how to convert the output of each method into an attention heatmap. Using Amazon's Mechanical Turk, we collect attention heatmaps on a variety of image types. Although all the interfaces capture some common aspects of attention, we find that they are best suited for different image types and tasks. For example, ZoomMaps is ideal for large, multi-scale visualizations; CodeCharts captures eye movements over time; ImportAnnots works well for graphic designs; and BubbleView is cheap but distorts the stimuli. This toolbox and our analyses facilitate exciting opportunities for gathering attention data at scale without an eye tracker for a diversity of stimuli and task types.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

For code, demos, and our full-length paper, please see our website:
http://TurkEyes.mit.edu/

Abstract ID: 196

Measuring the importance of temporal features in video saliency

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Matthias Tangemann[1] (matthias.tangemann@bethgelab.org), Matthias Kümmerer[1], Thomas S.A. Wallis[1,2], Matthias Bethge[1]; [1]University of Tübingen, [2]Amazon Research Tübingen (this work was done prior to joining Amazon)

Models predicting human gaze positions on still images have been greatly improved in the last years. Since motion patterns are an important factor driving human gaze as well (Rosenholtz 1999, Itti 2005, Dorr et al. 2010), there is growing interest in modelling human gaze positions on videos. In our work, we explore to what extent human gaze positions on recent video saliency benchmarks can be explained by static features. We apply models that cannot learn temporal patterns by design on the LEDOV and DIEM datasets and compare them to a gold standard model as an estimate of the explainable information. We first consider DeepGaze II (Kümmerer et al. 2017), the current state-of-the-art model for images, by applying it to every frame individually. To incorporate the time lag in human responses we consider two adaptations of DeepGaze II that predict gaze positions on the last frame of a fixed length window: First, we temporally average the predictions of DeepGaze II. Additionally we propose a new model "DeepGaze MR" that temporally averages image features and uses an adapted, nonlinear readout network to predict gaze positions. By design, all model variants are still not able to detect movements, appearances or interactions of objects. Our new model substantially outperforms previous video saliency models and explains 75% of the information on the LEDOV and 43% on the DIEM dataset. By analyzing failure cases of our model, we find that clear temporal effects on human gaze placement exist, but are rare in the benchmarks considered. Moreover, none of the recent video saliency models considered is able to predict human gaze in those cases better than our static baselines. To foster the data-driven modelling of temporal features affecting human gaze, we propose a meta-benchmark consisting of the hard cases found by our analysis.

Acknowledgements: We acknowledge support from the German Federal Ministry of Education and Research (BMBF) through the Tübingen AI Center (FKZ: 01IS18039A) and from the German Science Foundation (DFG): SFB 1233, Robust Vision: Inference Principles and Neural Mechanisms, project number 276693517.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1061

Modeling the dynamic nature of the center-bias

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Rotem Mairon[1] (rotem.mairon@gmail.com), Ohad Ben-Shahar[1]; [1]Ben-Gurion University of the Negev

When viewing natural images displayed on computer screens, observers show a considerable tendency to fixate their eyes more towards the center of the scene than any other image region regardless of its visual content. This so-called "center bias" is a well-known phenomenon that has been observed and examined in numerous studies on human eye movement behavior. Consequently, computational prediction of eye movements attempts to model the center bias in order to facilitate better estimation of the spatial distribution of human fixations. That being said, the center bias is often regarded merely a global spatial occurrence across complete scan paths. However, this view hinders any relation this bias may have with the dynamic nature of viewing. In the present work, we seek to uncover such relations by analyzing time-oriented gaze-paths both spatially and temporally. Indeed, both types of structures emerge, for example, in the way the center bias persists regardless of the current fixation location of an observer, or how it endures deep into the scan path. Based on these observations, we propose a more elaborate model of the center bias, that captures its manifestation in both space and time.

Acknowledgements: We acknowledge the support of the Frankel center for Computer Science research at BGU.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 814

Robust and Repeatable Approaches to Oculomotor Performance

Poster Presentation - *Topic area: Eye Movements: Measurement, models and mechanisms*

Silvio P. Sabatini[1] (silvio.sabatini@unige.it), Agostino Gibaldi[2]; [1]Dept. of Informatics, Bioengineering, Robotics and Systems Engineering - University of Genoa, Italy, [2]School of Optometry - UC Berkeley, CA, U.S.

Saccades are rapid ballistic eye movements that humans make to direct the gaze to an object of interest. The kinematics of healthy eye movements is well defined by a regular relationship between amplitude, duration and velocity, defined as the saccadic 'main sequence'. This relationship can be employed as a ready-to-use diagnostic tool to assess the integrity of the saccadic system. In fact, deviations of eye movements from the main sequence can be used as markers of specific neurological disorders. Despite its diagnostic significance, there is no consensus on the methodologies to obtain reliable and repeatable measurements of the main sequence. In this work, we propose a novel approach for standard indicators of oculomotor performance. The approach relies on two complementary parts: 1) a model saccade profile is used to provide robust and objective measurements of saccade kinematics, then 2) model fitting is used to provide a compact one-parameter characterization of oculomotor performance. The experimental procedure consists in a non-fatiguing and user-friendly task, like a free exploration of natural images. The obtained measurements show high repeatability, allowing for fine assessments of inter- and intra-subject variability, but also inter-ocular differences. The robustness of the model approach provides measurements that are relatively insensitive to the eye-tracking sampling frequency (down to 50Hz), thus allowing the use of low-cost technologies for a precise characterization of oculomotor performance. The limited invasiveness makes the method suited for fragile or non-collaborative subjects like neurological patients and infants. The method is released as a software toolbox for public use.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

This work proposes a reliable, fast and user-friendly method to measure oculomotor performance.
Go and check our toolbox, possibly also for a live demo:
https://sourceforge.net/projects/ema-toolbox/

Abstract ID: 1062

Eye Movements: Pursuit, salience

Evidence that a single vergence command does not drive smooth pursuit in depth

Talk Presentation - *Topic area: Eye Movements: Pursuit, salience*

Stephen Heinen[1] (heinen@ski.org), Scott Watamaniuk[2], Rowan Candy[3], Jeremy Badler[1], Arvind Chandna[1];
[1]Smith-Kettlewell Eye Research Institute, [2]Wright State University, [3]Indiana University

A unitary vergence command is believed to control the same muscle groups in the two eyes (e.g., medial rectus) to enact gaze shifts in depth (Hering, 1868). Hering also postulated that accommodation drives vergence, the basis for ocular control models that inform strabismus treatment. Last year we showed that during monocular smooth pursuit in depth, the covered eye often exhibits conjugate behavior despite appropriate accommodation (Heinen et al., VSS 2019). That result suggested that a conjugate command was contaminating the vergence signal, and implied a weak accommodation-vergence coupling. This year we provide additional evidence supporting both claims, and that also question the existence of a unitary vergence command. Observers pursued a motorized physical target (small letter "E") moving periodically in depth on the midline, between 33.3cm (3.0 dpt) and 66.7cm (1.5 dpt) with a peak velocity of 30cm/s. Viewing was either binocular or monocular with either eye. A Plusoptix photorefractor measured eye movements and accommodation from both eyes. The temporal delay (phase lag) of each eye relative to target motion was computed using cross-correlation. As expected, viewing eyes followed the target with near zero delay. Covered eyes however, were usually desynchronized with target motion, delayed by up to 2.6 sec. In contrast, covered eye accommodation delays were minimal, and were uncorrelated with gaze delays. The results suggest that during monocular midline pursuit, the covered eye is not under unitary vergence control and that accommodation in the viewing eye does not drive vergence in covered eye.

This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1610

Eye Movements Support Processing Spatial Configurations in Visual Working Memory

Talk Presentation - *Topic area: Eye Movements: Pursuit, salience*

J. David Timm[1] (dtimm@psycho.uni-tuebingen.de), Frank Papenmeier[1]; [1]University of Tuebingen, Germany

[Background] Previous research has shown that object locations are less memorized individually but rather dependent on the global spatial configuration consisting of all objects. Therefore, visual working memory performance is enhanced when the global configuration is shown at retrieval compared to a single object only. It is assumed that eye movements moderate this process. However, there are contrary findings whether eye movements support or attenuate configurational effects and with the present set of

experiments, we investigated to what extent the significance of spatial configurations in visual working memory depends on eye movements. [Methods] Participants encoded the locations of grey objects and performed a location change detection task for one object probed at retrieval. This object was displaced in half of the trials. Participants were always shown a global configuration in the beginning of the trial. After a delay period, either the spatial configuration or a single object was shown at retrieval. We manipulated whether participants were allowed to make eye movements. There were different conditions in which participants either were allowed to move their eyes normally or they had to fixate the center of the spatial configuration. [Results] The presentation of the spatial configuration supported the detection of location changes. Importantly, configuration effects were attenuated with enforced fixation, both with a whole trial fixation and with a respective phase fixation. [Conclusion] Our findings provide evidence for the memory advantage of spatial configurations and indicate that eye movements support processing spatial configurations in visual working memory. Future investigations should further evaluate these findings in relation to configurational effects in visual working memory and transsaccadic memory.

Acknowledgements: Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project number 357136437

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for checking out my VSS talk. Feel free to ask questions or give commentaries here in the chat or message me directly on a more "private" base via mail: dtimm@psycho.uni-tuebingen.de
We can also arrange short Skype/Zoom meetings if you are interested. Just drop me a message and we can arrange something.
Have a great conference!

Abstract ID: 3

How much time do you have? Introducing a multi-duration saliency model

Talk Presentation - *Topic area: Eye Movements: Pursuit, salience*

Camilo Fosco[1] (camilofosco@gmail.com), Anelise Newman[1], Patr Sukhum[2], Yun Bin Zhang[2], Aude Oliva[1], Zoya Bylinskii[3]; [1]Massachusetts Institute of Technology, [2]Harvard University, [3]Adobe

What jumps out in a single glance of an image is different than what you might notice after closer inspection. Despite this, current computational models of visual saliency predict human gaze patterns at an

arbitrary, fixed viewing duration (one image: one saliency map). This offers a limited view of the rich interactions between image content and gaze, and obscures the fact that different image content might be salient at different time points. In this paper we propose to capture gaze as a series of snapshots (one image: multiple saliency maps). Rather than aggregating individual scanpaths, we directly generate population-level saliency heatmaps for multiple viewing durations. Towards this goal, we turn to CodeCharts UI, a cost-effective interface for crowdsourcing gaze data without requiring an eye tracker. This interface provides precise control over timing, which allows us to gather attention patterns at different viewing durations. We collect the CodeCharts1K dataset with attention data for 0.5, 3, and 5 seconds of free-viewing on images from action, memorability, and out-of-context datasets. We find that gaze locations differ significantly across the three viewing durations but are consistent across participants within a duration, leading to multiple distinct heatmaps per image. Using insights from our analysis of human gaze data, we develop a temporally-aware deep learning model of saliency that simultaneously trains on data from multiple viewing durations. Our computational model achieves competitive performance on the LSUN 2017 Saliency Prediction Challenge when tested at the same viewing duration used for collecting the ground-truth human data. Importantly, our model also simultaneously produces predictions at multiple viewing durations. We discuss how knowing what is salient over different viewing windows can be used for image cropping, compression, and captioning applications.

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1005

Opposite effects of expectation on motion perception and anticipatory pursuit eye movements

Talk Presentation - *Topic area: Eye Movements: Pursuit, salience*

Xiuyun Wu[1] (xiuyunwu5@gmail.com), Austin Rothwell[1], Miriam Spering[1], Anna Montagnini[2]; [1]University of British Columbia, [2]Aix-Marseille University and CNRS

Smooth pursuit eye movements and visual motion perception rely on the integration of current sensory signals with past experience. Expectation derived from past experience can bias perception and even trigger smooth pursuit in anticipation of target onset (Maus, Potapchuk, Watamaniuk, & Heinen, 2015).

However, it is still unclear whether perceptual and pursuit biases are similarly affected by expectation. Here we compare biases in perception and anticipatory pursuit by probing both responses in a direction discrimination task. Observers (n=9 human adults) viewed random-dot kinematograms (RDKs) under different expectations of motion direction (right/left) while their eye position was recorded (Eyelink 1000). Context trials with high-coherence motion were used to build up a prior expectation of motion direction. Probability of rightward motion differed between blocks (50, 70, and 90%). Interleaved perceptual trials with low-coherence motion (0-15%) probed biases in direction discrimination and anticipatory pursuit magnitude. Observers tracked RDK motion with their eyes and reported perceived direction via button press. In experiment 1, motion coherence in context trials was 100%; in experiment 2 coherence was reduced to 20-30% to control for possible motion aftereffects due to sensory adaptation. Results showed that anticipatory pursuit was aligned with the expected direction (attraction bias). Perceptual judgments in low-coherence trials followed the direction opposite to the expected direction (repulsion bias). The size of both biases scaled monotonically with direction probability. Reducing motion coherence in context trials in exp. 2 significantly reduced anticipatory pursuit magnitude (e.g., velocity gain $F(1,8)=11.61$, $p=.01$). However, reducing coherence did not reduce perceptual bias ($F(1,8)=1.44$, $p=.26$), indicating that low-level sensory adaptation is unlikely to be the cause of the opposite bias in perception. We conclude that the repulsion bias in motion direction discrimination might be driven by higher-level processing and integration of motion signals.

Acknowledgements: This work was supported by a University of British Columbia four-year fellowship to X.W., an Natural Sciences and Engineering Research Council of Canada Discovery Grant and Accelerator Supplement to M.S., and an "APPVIS", PICS-CNRS grant to A.M..

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please see the slides attached with updated stats and supplementary figures in the end. The manuscript is in preparation, and the data will later be accessible online.

If you would like to contact me for any reasons, please email xiuyunwu5@gmail.com. Twitter interactions welcomed as well (@XiuyunWu5) :) Thanks!

Abstract ID: 567

The role of priors in controlling smooth pursuit eye movements of clear and noisy target motions: predictive pursuit does more than compensate for time delays

Talk Presentation - *Topic area: Eye Movements: Pursuit, salience*

Jason F. Rubinstein[1] (j.rubinstein@rutgers.edu), Manish Singh[1], Eileen Kowler[1]; [1]Rutgers University

Smooth pursuit predicts future target motion. Recent evidence suggests that pursuit may be modeled as a form of Bayesian cue combination, with extraretinal (prior) and sensory (likelihood) cues trading off in proportion to their respective reliabilities. This can be tested by statistical manipulation of the reliabilities of prior and likelihood. We studied pursuit of clear and noisy random dot kinematograms (RDKs) with mean directions of different levels of predictability. Mean RDK direction was chosen on each trial from a Gaussian prior, SD = 10° or 45°. The direction of each dot on each frame was each chosen from a Gaussian likelihood, SD = 0° - 60°. Pursuit direction remained close to the prior early in pursuit, when functions relating eye direction to mean RDK direction showed shallow slopes. Slopes increased over time at a slower rate for noisier RDKs, reaching values close to 1 as late as 600 ms after the onset of target motion for the noisiest RDKs. Slopes increased at a faster rate with the wide prior. With the narrow prior, SDs of pursuit direction were low for all levels of RDK noise. With the wide prior, SDs of pursuit direction were higher for the noisier RDKs. Results were analogous in a related perceptual task. The results could be accounted for by a model in which the direction of pursuit over time depended on a weighted combination of an extraretinal prior and sensory likelihood, with weights depending on their relative reliabilities, and the reliability of the likelihood representation increasing over time. The bias of pursuit direction due to reliable priors was accompanied by reduced directional variability during pursuit of noisy RDKs. The results suggest that a benefit of prediction (priors) for pursuit (similar to other types of Bayesian cue combination) is to improve precision when stimuli are noisy.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for the interest in my work and watching my talk!

In addition to the chat box and live presenter conferences, please feel free to contact me via email or on Twitter:

j.rubinstein@rutgers.edu
https://twitter.com/JasonRubinstein

The Annual Review on Predictive Smooth Eye Movements mentioned in the talk:
https://www.annualreviews.org/doi/full/10.1146/annurev-vision-091718-014901

https://www.ski.org/users/jason-rubinstein

Abstract ID: 1267

Eye Movements: Saccades

Asymmetric perception of shape change across saccades

Poster Presentation - *Topic area: Eye Movements: Saccades*

Carolin Hübner[1] (carolin.huebner@uni-marburg.de), Alexander C. Schütz[1]; [1]University of Marburg

Due to qualitative differences of visual information obtained from the periphery and the fovea, perception of objects can differ depending on their location in the visual field (Rosenholz, 2016). Together with an inherent tendency to perceive the environment as stable, this might result in biases in how we perceive changes in the environment. To investigate this, we examined change detection performance across saccades within one feature in respect to peripheral (presaccadic) and foveal (postsaccadic) perception. We changed an object's shape during a saccade from triangular to circular (TC), or vice versa (CT), and measured the point of subjective stability. Additionally, we tested the differences between peripheral and foveal shape perception, by measuring the point of subjective equality when the object appeared in the periphery or in the fovea only. The change discrimination task revealed that small CT changes were perceived as stable, whereas no change was more likely perceived as a TC change. In the shape perception task, we found peripheral perception being biased towards rounder percepts compared to foveal perception. Therefore, the bias for TC reports cannot be explained by relative biases in peripheral and foveal perception. Moreover, the bias does not represent a simple response bias, because it was also present in a criterion-free paradigm. This asymmetry in intrasaccadic change perception might be explained by a bias in transsaccadic prediction. Since angular shapes provide finer spatial detail than circular shapes, one might assume that the TC direction leads to a reduction in detail across a saccade. However, the usual perceptual experience might be that objects become richer in detail in the fovea after a saccade. Hence, there might be a weaker violation of transsaccadic prediction for a CT-direction change. This might explain why the environment appears stable, although the fovea reveals new details with every saccade.

Acknowledgements: This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 676786).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1006

Evidence for prediction in perceiving faces across saccades

Poster Presentation - *Topic area: Eye Movements: Saccades*

Christoph Huber-Huber[1] (christoph@huber-huber.at), David Melcher[1]; [1]University of Trento, Rovereto, Italy

Our perception of the world around us appears stable and continuous despite rhythmic interruptions in the form of saccadic eye movements. This apparent stability is achieved by integrating percepts from before and after a saccade in a seamless fashion. There is evidence that this trans-saccadic integration is predictive, in the sense that the visual system may anticipate what will appear in the fovea based on a peripheral preview. Here, we investigated to what extent this mechanism is predictive in terms of current notions of predictive processing and predictive coding. In Experiment 1, we investigated whether trans-saccadic integration flexibly adjusts to environmental contingencies as would be expected from a predictive process. We measured trans-saccadic integration in the form of a behavioral preview effect with face stimuli in a gaze-contingent experimental design. Participants made cued saccades to peripheral stimuli. During the saccade, the face could change its orientation (upright-to-inverted/inverted-to-upright) or remain the same. In addition, the post-saccadic target face exhibited a slight tilt. The task was to discriminate whether the target face tilt was to the left or to the right. A strong preview effect demonstrated better post-saccadic face tilt discrimination when the face remained the same compared to when it changed. Crucially, this preview effect could be modulated by a preceding training period with 100% change versus 100% no-change trials. A single-trial, mixed-model analysis showed that the effect continued to adapt to statistical regularities after the training session. In Experiment 2, we investigated the neural basis of the preview effect with combined MEG and eye-tracking in a similar experimental design. Fixation-related field results show that the neural basis of the behavioral preview effect exhibits properties of a prediction error signal and suggests that certain stages of trans-saccadic integration can be interpreted in terms of predictive coding.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1131

Express saccades optimize reward rate in a saccade countermanding task

Poster Presentation - *Topic area: Eye Movements: Saccades*

Steven P. Errington[1] (steven.p.errington@vanderbilt.edu), Jeffrey D. Schall[1]; [1]Vanderbilt University

Express saccades are commonly produced under predictable task conditions. Here we report the production of express saccades in a saccade countermanding task, where conditions strongly discourage express saccades. To perform this task, monkeys fixated a central spot whereupon after a variable time the central spot was extinguished and a peripheral target appeared simultaneously at one of two random locations on the left or right (no-stop trials). On ~30% of trials, after a variable delay, the central spot reappeared, instructing monkeys to cancel the planned saccade to the peripheral target (stop-signal trials). Monkeys were rewarded with juice for generating saccades to targets on no-stop trials and for maintaining fixation on stop signal trials. Saccade latencies in this task are notably longer than values obtained in a simple reaction time task because the monkeys adapt to the stop signal by slowing performance. However, we observed some monkeys producing saccades with response times <100 ms. Indeed, we observed bimodal distributions of saccadic latencies, characteristic of express and regular saccades. Simulations revealed that reward rate can be optimized by varying the proportion of express saccades made within a session. The monkeys exploited this opportunity. When production of express saccades was not rewarded, monkeys made significantly fewer. This study highlights the many ways in which cognitive control of visually guided gaze behavior can exploit niches of opportunity.

Acknowledgements: Supported by R01-MH55806, P30-EY08126, and by Robin and Richard Patton through the E. Bronson Ingram Chair in Neuroscience

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hi! If you have any questions or comments on this poster, I will be available to chat on the Zoom link from 2pm to 3pm CDT (7pm to 8pm UTC) on June 19, 2020. Alternatively, please email me at steven.p.errington@vanderbilt.edu. I look forward to hearing from you!

Abstract ID: 121

Induced Simultanagnosia in a Saccadic Persistence of Vision Display

Poster Presentation - *Topic area: Eye Movements: Saccades*

Rolf Nelson[1] (nelson_rolf@wheatoncollege.edu), Jason Goodman[1], Katherine Eskine[1], Augustus Kram Mendelsohn[1], Michael Vallerie[1]; [1]Wheaton College (MA)

A form of simultanagnosia in visually unimpaired individuals was found for objects presented during saccades. 18 college-age observers were asked to draw their percepts after making saccades across an LED strip that "painted" an image on their retinas by presenting sequential columns of a bitmap at a speed to match a 30 degree saccade. During experimental trials, repetitions of a single letter (either "A", "X", "H", or "V") were presented across saccades. Although an average of six letters were presented across each saccade, observers nearly always indicated perceiving only a single instance of the letter in their drawings. This inability to perceive multiple instances of a letter was not due to a limited region of attentional processing, as it only attained for multiple instances along the axis of the saccade -- horizontal saccades did not affect perception of multiple letters along the vertical axis. This effect is likely due to known mechanisms of suppression of visual areas during saccades, particularly the medial temporal and inferior pulvinar regions (Berman et al., 2017).

Acknowledgements: Wheaton College

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Hi

Abstract ID: 529

Selective enhancement of motion perception for small, low contrast stimuli immediately after saccadic eye movements

Poster Presentation - *Topic area: Eye Movements: Saccades*

Adela SY. Park[1], Alexander C. Schütz[1]; [1]University of Marburg

Saccadic eye movements have drastic consequences for motion perception: during saccades, the perception of visual motion is attenuated by the fast motion of the eyes (Burr & Ross, 1982; Castet & Masson, 2000). After saccades, reflexive tracking movements in response to large field motion are enhanced and this response is well correlated with post-saccadic enhancement of neural activity in the primate motion processing areas (Takemura & Kawano, 2006). Currently it is unclear how this postsaccadic enhancement is achieved. Therefore, we tested if the enhancement is related to the balance of centre-

surround antagonism in motion processing, favouring spatial summation at low contrasts and surround suppression at high contrasts (Tadin et al., 2003). We investigated the influence of saccades on motion direction discrimination by presenting Gabor stimuli following horizontal saccadic eye movements. The Gabors had a spatial frequency of 1 cpd and were drifting vertically inside a stationary aperture at a speed of 2 deg/s. We measured minimum duration thresholds for small and large (0.7 and 5 deg diameter) and low and high contrast (2.8 and 92%) Gabor stimuli presented immediately after saccade offset or with a delay of 300 ms. For small, low contrast stimuli, motion discrimination thresholds were lower directly after the saccade than 300 ms later. This enhancement of motion sensitivity was not present for large stimuli or high contrast stimuli, resulting in a smaller amount of spatial summation for low contrast stimuli. Our results could be interpreted in the sense that the amount of spatial summation is transiently reduced after saccades or that a non-linearity in motion processing leads to the selective enhancement of sensitivity for weak, i.e. small and low contrast stimuli immediately after saccades. Either way, visual sensitivity is altered after saccades, possibly to maximize sensitivity for the saccade target as the primary object of interest.

Acknowledgements: This project has received funding from the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (grant agreement No 676786).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1027

Separate systems for transsaccadic comparisons of object orientation vs. identity in human cortex: An fMRI paradigm

Poster Presentation - *Topic area: Eye Movements: Saccades*

Bianca Baltaretu[1,2,3] (b.baltaretu@gmail.com), J Crawford[1,2,3,4]; [1]Centre for Vision Research, York University, Toronto, ON, CA, [2]Vision, Science to Applications (VISTA) program, York University, Toronto, ON, CA, [3]Department of Biology, York University, Toronto, ON, CA;, [4]Departments of Psychology, Kinesiology & Neuroscience Diploma Program, York University, Toronto, ON, CA;

Recently, Dunkley et al. (Cortex, 2016) showed that extrastriate cortex and right supramarginal gyrus (SMG) were modulated by transsaccadic changes in the orientation of a Gabor-like patch. However, this result did not generalize to other features: in a similar fMRI design, Baltaretu et al. (J Vis, 2016) found that

transsaccadic changes in spatial frequency activated medial occipito-parietal and middle frontal gyrus (MFG). Based on this, we hypothesized that the fundamental difference between these results was the detection of transsaccadic changes in object orientation vs. identity. To test this, we used a double-dissociation fMRI task. Participants were asked to fixate on a small cross 15.4° left or right of centre, where an object was subsequently presented (rectangle, barrel-shaped object, or hourglass-shaped object), oriented at ±45° from vertical. After this, the fixation cross either remained in the same position (Fixate condition) or shifted to the other side (Saccade condition). Then, either the same object would appear with the opposite orientation (Orientation change condition) or one of the other two objects would appear at the same orientation (Identity change condition). Participants were required to indicate whether identity or orientation had changed using a button press. Preliminary analysis in seven participants, using an RFX GLM and a (Saccade Orientation > Identity) > (Fixation Orientation > Identity) contrast, showed that right SMG, inferior occipital gyrus, and left somatosensory and superior parietal lobe were significantly modulated by transsaccadic changes in object orientation. In contrast, right MFG, left primary motor cortex, and bilateral precuneus were significantly modulated by transsaccadic changes in object identity. These results support our hypothesis that separate anterior lateral (SMG) vs. posterior medial (precuneus) parietal nodes, respectively, are involved in the monitoring of object orientation versus identity across separate visual fixations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Thank you for your interest and visiting this poster! If you have any comments or questions, feel free to email me at brb@yorku.ca or DM me on Twitter at @BBaltaretu.

Abstract ID: 753

The peripheral sensitivity profile reshapes during saccade preparation

Poster Presentation - *Topic area: Eye Movements: Saccades*

Lisa M. Kroell[1,2] (lisa.m.kroell@gmail.com), Martin Rolfs[1]; [1]Humboldt-Universitaet zu Berlin, [2]Berlin School of Mind and Brain

While scanning our environment, we move our eyes around three times per second. Each of these saccades is preceded by an attention shift, increasing visual sensitivity at the saccade target. Previous studies suggest that pre-saccadic enhancement is more pronounced for high than for low spatial frequency (SF) content (Li, Pan, & Carrasco, 2018). This conclusion, however, relies on experimental designs that probed sensitivity to a small range of SFs. Relative enhancement benefits for high over low SFs may therefore reflect local

changes in the sensitivity profile which do not transfer to a wider range of SFs. To assess the impact of saccade preparation on the overall shape of the peripheral sensitivity profile, we asked observers to make a saccade towards one of two dynamic noise streams presented at 10 dva eccentricity. Before the eye movement, an oriented grating (the probe) appeared at the saccade target and observers reported its orientation. Crucially, the probe's SF varied across trials, ranging from 1–5.5 cyc/deg. In order to describe the shape of the sensitivity profile, we fitted log-parabolic functions to measured accuracies. During saccade preparation, the profile shifted upwards, resulting in an increase in peak sensitivity (i.e. the maximum accuracy obtained). As the probe appeared closer to saccade onset, the SF at which participants reached peak sensitivity increased gradually. We furthermore observed a decrease in the bandwidth of the profile. In accordance with previous findings, the combination of these modulations entailed that pre-saccadic enhancement increased with SF up to 2.5 cyc/deg. Sensitivities to even higher SFs, however, profited less from saccade preparation. We conclude that pre-saccadic sensitivity changes at the saccade target are best described as a global reshaping of the peripheral sensitivity profile. As a consequence, peripheral sensitivities may gradually emulate the characteristics of foveal vision.

Acknowledgements: This research was supported by the German Research Foundation (DFG, grants RO3579/9-1 and RO3579/8-1)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

If you have questions or feedback, feel free to contact me (lisa.maria.kroell@hu-berlin.de).

Abstract ID: 709

Trans-saccadic memory of orientation and form

Poster Presentation - *Topic area: Eye Movements: Saccades*

Lukasz Grzeczkowski[1] (lukasz.grzeczkowski@gmail.com), Heiner Deubel[1]; [1]Ludwig-Maximilian University

The content and nature of transsaccadic memory (TSM) is still a matter of debate. While considerable evidence supports the view that TSM relies on visual short term memory (VSTM), the evidence backing a maskable, volatile spatiotopic visual buffer is sparse. Here, we present data supporting the latter. In the first study, we investigated the TSM of a visual feature, namely stimulus orientation as well as its potential luminance contrast dependency. Observers saccaded to a grating and discriminated an orientation change occurring during the eye movement. The post-saccadic grating was presented either with or without a 200 ms blank, and was either iso- or anisoluminant. With anisoluminant gratings we observed an improvement of discrimination with a blank, i.e., a blanking effect for orientation. Interestingly, the blanking did not bring benefit to the discrimination of the isoluminant gratings. In a second study, we examined whether blanking would also support TSM of stimulus form. Observers saccaded to a peripheral checkerboard-like stimulus and reported whether an intrasaccadic change had occurred in its upper or lower half. On 50% of the trials, the stimulus was blanked for 200 ms with saccade onset. Results show that stimulus blanking improved transsaccadic change discrimination. Moreover, they demonstrate that the blanking effect is spatiotopic (or object-based) and does not occur without a saccade. Our findings argue in favor of a remapped form of TSM having different characteristics than VSTM. We show that this TSM can be accessed via stimulus blanking or when the post-saccadic stimulus is weak (isoluminant).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 737

Transsaccadic Updating: Evidence for Overwriting of Color Information

Poster Presentation - *Topic area: Eye Movements: Saccades*

Jessica Parker[1] (jparke87@vols.utk.edu), A. Caglar Tas[1]; [1]University of Tennessee, Knoxville

The present study investigated mechanisms of transsaccadic object updating. We have previously shown that the pre-saccadic representation of the saccade target object is overwritten by its post-saccadic representation when visual stability is established (Tas & Hollingworth, ECEM 2019). However, other studies have shown that the pre- and post-saccadic representations are instead integrated across saccades (e.g., Wolf & Schutz, 2015). An important difference between these studies was the task instructions. In our previous experiments, we asked participants to report either the pre- or the post-saccadic feature of the saccade target. However, studies which found integration effects asked participants to report the feature of the target without specifying different states (pre-saccadic or post-saccadic) which may promote an integration mechanism. The present study tested this possibility. Participants executed a saccade to a colored disk. On half of the trials, the target's color was changed by 15° during the saccade. After each trial, participants were asked to report the color of the target object by clicking on the corresponding color on a color wheel (integration block). Participants also completed two blocks where they saw the target either only pre-saccadically or only post-saccadically. Replicating our previous study, the response distributions of

the integration trials were better fit by a bimodal than a unimodal model, providing evidence against integration. Further, participants consistently reported the post-saccadic color, indicating overwriting of the pre-saccadic color. Next, we tested whether integration trials resulted in better performance compared to the best single condition (pre-only or post-only block). We again found no evidence for integration: Color reports were not significantly more precise in the integration block compared to the best single performance. Together, these findings indicate that the visual system can keep the pre- and post-saccadic representations separate, and the pre-saccadic feature is often overwritten by the post-saccadic feature.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 8:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1327

Transsaccadic integration depends on feature-level correspondence

Poster Presentation - *Topic area: Eye Movements: Saccades*

Garry Kong[1], David Aagten-Murphy[1], Jessica McMaster[1], Paul M Bays[1]; [1]University of Cambridge

Our knowledge about relevant objects in our environment reflects an integration of current visual input with information acquired during preceding gaze fixations. For this accumulation of input to be of benefit, the visual system must determine what information should be integrated and what should be segregated. To investigate the basis of this decision, in Experiment 1, participants first viewed a colored disk in their peripheral vision, then made a saccade that shifted the object into the opposite hemifield. During the eye movement, the object underwent changes of varying magnitude in its color and/or location. Participants were asked to detect whether the object had changed in any dimension as well as report the post-saccadic color from a color wheel. Integration was observed as a bias in the color report in the direction of the pre-saccadic color. The magnitude of the color change was found to influence the bias in color reports, indicating reduced integration for larger changes. In contrast, changes in the object's location, while detected with similar frequency, had no significant effect on the integration of pre-saccadic with post-saccadic color. Experiment 2 replicated this finding using orientation as the secondary feature dimension in place of location. In Experiment 3 participants were unpredictably asked to report either color or orientation on each trial, equating attention. Here, changes in orientation reduced the amount of transsaccadic color integration, but only weakly. These results suggest that the decision to integrate or

segregate feature information across fixations depends on whether a change in that feature is detected, but is largely independent of changes in other features of the same object.

Acknowledgements: This research was funded by the Wellcome Trust

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 8:00 am EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1066

Eye Movements: Visual search

A confirmation bias in how humans actively sample sensory information

Poster Presentation - *Topic area: Eye Movements: Visual search*

Ankani Chattoraj[1] (achattor@ur.rochester.edu), Ra Yong Soo[1], Katherine Moon[1], Sabyasachi Shivkumar[1], Ralf Haefner[1]; [1]University of Rochester

We interpret visual scenes by making eye-movements in different locations and accumulating corresponding evidence. A recent work (Yang et al 2016) showed that humans make goal-driven eye-movements in a gaze-contingent paradigm of a visual categorization task so as to maximize information about the correct category while incorporating the already acquired evidence about the scene. Other studies investigating temporal integration of information have shown that humans are often, but not always, biased to overweight early evidence (“primacy effect”, Nienborg et al. 2009, Kiani et al 2008). In the present study we therefore ask: are we biased to rely on accumulated foveal vision information when selecting locations to saccade to based on peripheral vision of possible evidence targets? Unlike in previous studies, we allow subjects to choose the saccade locations instead of revealing experimenter decided specific locations. We design two experiments in 2AFC paradigm: in Experiment 1, the subject first fixates on a band passed gabor stimulus either oriented +45 degrees or -45 degrees while two or three stimuli (fixed per trial, random across trials) appear in the periphery and the subject is allowed to saccade to one

of them. After three such saccades, the subject has to report the dominant orientation. In Experiment 2, a subject sees 18 black ellipses on a gray background screen some of which are vertical and some are horizontal and is allowed to make eye-movements freely for 1.5 secs before choosing which orientation dominates. In both experiments we find some evidence that integrated information from already fixated locations drive eye movement such that the next fixation is at a location whose evidence confirms the belief about the correct category based on evidence already integrated. Our results investigate the role of active vision on perceptual decision making, here saccades, attempting to close the action-perception loop.

Acknowledgements: R01 EY028811-01

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1689

Deployment of attention in depth is biased to closer objects: An eye-tracking study

Poster Presentation - *Topic area: Eye Movements: Visual search*

Thorsten Plewan[1] (plewan@ifado.de), Gerhard Rinkenauer[1]; [1]Leibniz Research Centre for Working Environment and Human Factors

Previous research revealed that attention is not uniformly distributed across 3D space. Some results indicate that there is an egocentric attentional gradient through space. Accordingly, objects located closer to an observer are expected to summon attention more than those located farther away. So far, experimental evidence was limited to analyses of behavioral responses. Thus, in the present investigation eye movements were recorded while participants performed a visual search task in virtual 3D space. Vertical line segments (12 or 24 items) were distributed across two or four depth planes. In each trial, participants had to judge whether a line segment was tilted or not (target present/absent). Participants tended to identify closer targets faster than those located farther away. This effect was evident irrespective of the search volume's size (12 or 24). Analysis of eye movements revealed that the number of fixations substantially varied across depth planes. Overall, more fixations on items located in the nearest depth plane were recorded. Beyond this plane, fixations were evenly distributed. Therefore, the present results suggest that items of a 3D search array are more likely to be selected if they are located closer to an observer. This adds further empirical evidence to the idea that visual search in (virtual) 3D space operates

along an egocentric attentional gradient. This might be of particular importance if foreknowledge about the target depth plane is not available. Moreover, the results indicate that visual information beyond the fixated depth plane is not completely neglected. Covert shifts of attention between different depth planes may be used to integrate additional information. Accordingly, investigation of eye movement patterns can be regarded as useful and important tool to obtain a deeper understanding of attentional mechanisms in (virtual) 3D space.

Acknowledgements: This work was supported by the "Center of Excellence for Logistics and IT" founded by the Ministry of Innovation, Science and Research of the State of North Rhine-Westphalia, Germany.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have questions or comments, please do not hesitate to get in touch with me!
Plewan@ifado.de

Abstract ID: 1060

Face processing in free viewing visual search: An investigation using concurrent EEG and eye movement recordings

Poster Presentation - *Topic area: Eye Movements: Visual search*

Damian Care[1] (damianos.care@gmail.com), Bruno Bianchi[1], Juan Esteban Kamienkowski[1,2], Matias J. Ison[3]; [1]Laboratorio de Inteligencia Artificial Aplicada, Instituto de Ciencias de la Computación, Universidad de Buenos Aires - Consejo Nacional de Investigaciones en Ciencia y Técnica, Argentina., [2]Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina., [3]School of Psychology, University of Nottingham, United Kingdom.

The neural underpinnings of face processing have largely been investigated under fixed-gaze. The electrophysiological hallmark of face processing is the N170 component, which emerges in the occipitotemporal cortex around 170 ms after stimulus onset and is characterized by a larger amplitude in response to pictures of faces, compared to other object categories. Several properties modulating this component have been extensively studied, including its sensitivity to face inversion and low-level manipulations (see, e.g. Rossion, 2015). However, little is known about face processing in natural viewing. A recent study (Kamienkowski, Varatharajah, Sigman & Ison, 2018) reported strong fixation-related potentials (fERPs) to faces in a free-viewing visual search task and a significant difference between target and distractor faces around 170 ms after fixation. In this study, we co-registered EEG and eye tracking to

investigate fERPs to pictures of faces and objects during visual search and free exploration. Participants were asked to search for one target face or object stimulus during visual search blocks (VS) and to explore an array of faces and objects embedded in random noise during free exploration (EXP). We hypothesized that a larger N170 would be elicited by fixations to faces in comparison to objects. Importantly, based on a recently proposed framework (Kamienkowski et al., 2018), we also hypothesized that the early target detection that has previously been reported largely reflects saccade inhibition, and would therefore be activated differently for easy distractors (different categories) than hard distractors (same category). Preliminary analyses of the fERPs show robust early potentials, but no differential activation for different categories. Possible interpretations in terms of differences in low-level features, reduced signal to noise ratio and superposition of brain potentials are discussed.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1691

How does expected search difficulty affect target template generation and search performance?

Poster Presentation - *Topic area: Eye Movements: Visual search*

Natalie Paquette[1], Joseph Schmidt[1]; [1]University of Central Florida

As search difficulty increases, search performance decreases (e.g. Huang & Pashler, 2005), and the amount of target related detail held in visual working memory (VWM), as measured by contralateral delay activity (CDA), increases (Schmidt & Zelinsky, 2017). However, it is unclear how the expectation of search difficulty interacts with the actual level of search difficulty, and how the amount of target related visual detail maintained in VWM modulates the expectancy effects. This study aimed to isolate the effects of expected and actual search difficulty using eye movements and to measure the target representation using CDA. Participants pictorially previewed (200 ms) and then searched for a target Landolt-C which appeared among oriented distractor C's. CDA was assessed during the delay following preview offset but before search onset (1000 ms). Target-distractor similarity was manipulated to generate easy, moderate, and difficult search blocks. Importantly, blocks contained 25% of trials from the unexpected difficulty level to assess how search performance changed when expected difficulty mismatched actual search difficulty.

Consistent with previous findings, our results indicate decreased accuracy ($p < .01$) and increased reaction time ($p < .05$) as search difficulty increased. This difference was also modulated by expected search difficulty, such that if an easier search was expected, accuracy and RT decreased. However, if a more difficult search was expected, accuracy and RT increased. Significant CDA was also observed in all difficulty conditions ($p < .01$), however, differences between conditions have not yet risen to the level of significance. Our current eye movement data suggest that expected search difficulty modulates search performance, however, the relationship to the target template is currently unclear.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 918

Multiple Functional Visual Fields (FVFs) surround the same fixation point during visual search

Poster Presentation - *Topic area: Eye Movements: Visual search*

Sneha Suresh[1,2] (ssuresh1@bwh.harvard.edu), Chia-Chien Wu[1,2], Daniela Gresch[3], Jeremy M. Wolfe[1,2]; [1]Department of Surgery, Brigham & Women's Hospital, [2]Departments of Ophthalmology and Radiology, Harvard Medical School, [3]Department of Experimental Psychology, Ludwig-Maximilians-Universität München

When observers search for targets, they do not fixate every spot in the image. It follows that there must be a region that is processed around each fixation. This is referred to as the “Functional Visual Field” (FVF). Traditionally, the FVF has been treated as one entity. We argue that there are three FVFs at play in a search task, answering three different questions: What can be resolved if attention is directed toward it? What will be covertly attended during this fixation? Where will I explore with my next fixation? Experiment 1: Observers searched for a single target letter T among distractor Ls while the eyes were tracked. Once the target letter was clicked, a new target would appear at a random location. All letters rotated randomly to mask transients. When the next saccade landed on a target, that target must have fallen within the FVF(attend) for the previous fixation. Preceding saccades were exploring saccades, seeking to get a target inside FVF(attend). On average, these FVF(explore) saccades were significantly longer than the final FVF(attend) saccade (paired t-test, $p<0.001$). In Experiment 2, Ts and Ls were intermixed with smaller consonants and vowels. Observers searched for Ts, Vowels, or both in separate blocks. Again, FVF(explore) saccades were significantly longer than the final FVF(attend) saccade. Additionally, explore saccades were

longer on T blocks than on Vowel blocks (p=0.006). Attend saccades were longer for Ts and Vowels, but not significantly. Our results show that task difficulty affects the size of FVF(explore) and probably of FVF(attend). FVF(resolve) is limited by acuity and crowding and depends on the stimulus. FVF(attend) and FVF(explore) are further controlled by other factors. For example, if the T was red, you could saccade to red items (FVF(explore)) that were too far away to resolve or attend.

Acknowledgements: NIH EY017001 / CA207490

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 716

Spatiotemporal dynamics of foveal visual search

Poster Presentation - *Topic area: Eye Movements: Visual search*

Sanjana kapisthalam[1] (skapisth@ur.rochester.edu), Martina Poletti[1]; [1]University of Rochester

The concept of visual search is normally associated with large saccades, which are used to explore the visual scene by placing the high-resolution fovea on the stimuli of interest. However, we previously showed that, once the object of interest is foveated, observers engage in active exploration of foveal details using precisely guided microsaccades. Here we investigated the spatiotemporal dynamics of foveal exploration, and the contribution of top-down and bottom-up factors in driving visual search at this scale. Subjects (n = 8) were instructed to search for a target, a small tilted bar (1x8 arcminutes in size), in an array of 7 similar items presented foveally. The search array spanned 0.5 deg, approximately half of the size of the foveola, and was presented for 1s. The task-relevance and salience of each item in the array was manipulated independently. Salience was modulated by changing the contrast level of the stimuli, whereas task relevance was modulated by changing the similarity of each item to the target. Gaze position was tracked by means of a high-precision eyetracker. Our results show that, even if all the stimuli were presented foveally, subjects engage in active visual search, using microsaccades as small as 10 arcminutes. When multiple items of similar relevance are present in the foveal landscape, it takes approximately 500ms for the system to establish a priority map and drive an eye movement toward the search target. This time is reduced on average by 150ms, and the accuracy of fine oculomotor behavior is increased, when the target is perceptually salient. Furthermore, salient distractors do not appear to influence oculomotor behavior and performance in the task. These findings suggest that the search pattern is modulated by saliency at the

foveal scale, and that salient distractors are actively inhibited at no-cost for the visual system during foveal search.

Acknowledgements: funded by Facebook, Inc.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 885

Through the eyes of an expert: Evaluating holistic processing in architects using gaze-contingent viewing

Poster Presentation - *Topic area: Eye Movements: Visual search*

Taren Rohovit[1] (tren63@gmail.com), Spencer Ivy[1], Mark Lavelle[1], Jeanine Stefanucci[1], Dustin Stokes[1], Trafton Drew[1]; [1]University of Utah

Studies in the psychology of visual expertise have tended to focus on a limited set of expert domains; largely in radiology and athletics. Conclusions drawn from these data indicate that experts use parafoveal vision to process images holistically. In this study, we examined a novel, as-of-yet-unstudied class of visual experts – architects – expecting similar results. However, our study's data indicate that architects, though visual experts, do not employ the holistic processing strategy analogously to their previously studied counterparts. Participants (n=24) were asked to find targets in x-rays and perspectival images. These images were presented in both gaze contingent and normal conditions. Consistent with the holistic processing model, we expected two results. First, architects would display a greater difference in saccadic amplitude between the gaze contingent and normal conditions. Second, architects would spend less time per search than an undergraduate control group (n=24). However, we found that although the architects were more accurate in the perspectival task, they took more time and displayed a lower difference in saccadic amplitude than the controls. Both undergraduates and architects were equally inaccurate when searching for targets in radiographs, suggesting that visual expertise may not generalize across domains. Our research indicates a disjunctive conclusion. Either architects are simply different kinds of visual experts than those previously studied, or we have generated a task that employs visual expertise without holistic processing. Our data suggest a healthy skepticism for across-the-board inferences collected from a single domain of expertise to the nature of visual expertise generally. Although holism may be a feature of some experts' 'perceptual powers,' we conclude that our data reveal a limit to this law.

Acknowledgements: Kickstart Grant: University of Utah College of Humanities

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 294

Eye movements: Saccades and perception

A post-saccade blank interferes with transsaccadic displacement detection in real-world scenes

Talk Presentation - *Topic area: Eye movements: Saccades and perception*

Deborah Cronin[1] (debcronin3@gmail.com), John Henderson[1]; [1]University of California, Davis

With each saccade the position of visual information falling on the retina shifts. Despite these transsaccadic disruptions, we perceive a stable visual world. This stability persists even when stimuli move during saccades, as shown by poor transsaccadic displacement detection (e.g., Mack, 1970). In simple stimuli, displacement detection improves dramatically when stimuli briefly disappear at the conclusion of the saccade (e.g., Deubel et al., 1994). This "blank" effect is taken as evidence that the visual system assumes stability unless provided contrary evidence like that introduced by the blank period. The present study examined whether a post-saccade blank similarly improves displacement detection in real-world scenes, as the stability assumption hypothesis predicts. In two experiments, participants were cued to move their eyes away from central fixation to the left or right while viewing a real-world scene. On some trials, the entire scene moved 2° (E1) or 4° (E2) while their eyes were in motion. On half of the trials (i.e., the blank condition), the scene was briefly absent at the conclusion of the eye movement before returning to view. Participants responded whether or not they detected a scene displacement. In contrast with previous work and with our own control experiment (E3), the post-saccade blank screen impaired displacement detection in scenes. Participants were less sensitive (d') to scene displacements in the blank condition (E1: $p < 0.001$, $d = 0.99$; E2: $p < 0.001$, $d = 1.45$). In contrast, participants were more sensitive to simple stimuli displacements with the post-saccade blank ($p = 0.002$, $d = 0.91$), replicating the classic effect. These results suggest that the blank effect does not scale up to complex scene images, and calls into question the generality of the stability assumption hypothesis that has found support in studies of simple visual stimuli.

Acknowledgements: This research was supported by the National Eye Institute of the National Institutes of Health under award number R01EY027792.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

I'm unable to schedule live presenter conferences, so please leave any questions or comments in the chat or send me an email. Thank you for your interest in my work!

Abstract ID: 1324

Cortical network hubs for perisaccadic visual processing: evidence from high resolution EEG and graph theory analysis

Talk Presentation - *Topic area: Eye movements: Saccades and perception*

Amirhossein Ghaderi[1,2] (ghaderi@yorku.ca), Matthias Niemeier[3,1,2], John Douglas Crawford[1,2,4,5,6]; [1]Centre for Vision Research,York University, Toronto, ON, Canada, [2]Vision Science to Applications (VISTA) Program, York University, Toronto, ON, Canada, [3]Department of Psychology, University of Toronto Scarborough, Toronto, ON, Canada, [4]Department of Biology, York University, Toronto, ON, Canada, [5]Department of Psychology, York University, Toronto, ON, Canada, [6]Department of Kinesiology and Health Sciences, Toronto, ON, Canada

Various spatial and temporal distortions occur around the time of a saccade (Morrone et al. Nature Neuroscience 2005), presumably associated with disruptions in cortical networks. However, these effects have not been investigated using network science approaches like graph theory analysis (GTA). Here, we constructed functional brain networks in a perisaccadic state, then evaluated which cortical regions play the role of hubs. Electroencephalography (EEG) was recorded via 64 channels in two behavioral conditions. Participants (N=9) were pre-cued with a series 1-3 grids (three horizontal lines, 10° by 10°) located 5° below the central fixation-point. In the saccade condition, saccades (recorded by Electrooculography) were cued by a sudden shift of the fixation-point to 10° left/right. 100ms later, a stimulus (three vertical lines; same size/location) was briefly presented (for 70ms). Saccades were occurred after the stimulus presentation. Fixation condition was identical, except the fixation-point remained in the centre. LORETA source localization was performed on the 200ms period following the saccade cue, or the equivalent time during fixation trials. Instantaneous coherences were calculated between all pairs of 84 Brodmann areas. GTA was implemented to find eigenvector centrality (EC) of all areas. Nonparametric permutation test showed significant enhancement of EC (gamma-band) for the saccade task (relative to the fixation task) in right inferior parietal cortex (Brodmann areas 39, 40, 41), left inferior parietal cortex (areas 39, 40) and right

frontal cortex (area 8). These results suggest that inferior parietal regions, especially bilateral supramarginal gyrus (SMG), and right frontal eye field (FEF) are involved in information processing for perisaccadic visual processing and participate as hubs in the functional perisaccadic network. These results are consistent with studies that suggest the role of FEF and SMG as important regions in saccadic memory and integration (Prime et al. Cerebral Cortex 2009; Dunkley et al., Cortex, 2016).

Acknowledgements: Grant Support: NSERC Discovery Grant VISTA Fellowship, supported by the Canada First Research Excellence Fund Canada Research Chair Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 548

Decoding 3D spatial location across saccades in human visual cortex

Talk Presentation - *Topic area: Eye movements: Saccades and perception*

Xiaoli Zhang[1] (thuzxl@gmail.com), Christopher M Jones, Julie D Golomb; [1]The Ohio State University

Visual signals are initially processed as two-dimensional images on our retina. To perceive a 3D world, depth information can be reconstructed from the binocular disparity between the 2D retinal images from both eyes. However, in daily life, we make frequent eye movements and consequently the 2D retinal inputs constantly change. How is depth position represented in the brain across saccades compared to during sustained fixations? In an fMRI scanner, while wearing red-green anaglyph glasses to facilitate 3D perception, participants passively viewed a random dot patch that stimulated one of four 3D locations in each 16-second block. Each location was defined by its 2D position (above or below screen center; vertical information), and its depth position (in front of or behind central screen plane). Participants fixated on a fixation dot located at the vertical center and the screen depth plane, but offset horizontally either to the left or right of the screen center. In half of the blocks, the fixation dot remained in the same location throughout the block (no-saccade blocks). In the other blocks, the fixation dot repeatedly alternated between the left and right sides to trigger saccades (saccade blocks). With multivariate pattern analysis, we could decode depth information in no-saccade blocks in intermediate/later visual areas, consistent with previous studies. Importantly, in saccade blocks, despite the retinal changes in horizontal position induced by the saccades, we could decode depth information to a similar extent as in no-saccade blocks. In contrast, little vertical or depth information could be decoded across no-saccade blocks with different eye positions

in any visual areas, indicating eye-position-dependency during stable fixation. In conclusion, representations of spatial locations (2D and depth) may become more tolerant of eye positions during “dynamic” saccades, perhaps due to active remapping during saccades which may encourage more stable representations of the world.

Acknowledgements: This study is funded by NIH grant R01-EY025648 (JG) and NSF 1848939 (JG)

This talk will be presented in Live Talk Session 3, Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 546

Peri-saccadic attention drives saccade statistics in scene viewing

Talk Presentation - *Topic area: Eye movements: Saccades and perception*

Lisa Schwetlick[1] (lisa.schwetlick@uni-potsdam.de), Lars O. M. Rothkegel, Ralf Engbert; [1]University of Potsdam

Fixation location and locus of visual attention are usually assumed to coincide when modeling attention in natural scene viewing. However, research finds preferred processing at locations decoupled from eye position around the time of a saccade. Activation peaks occur at the upcoming location just before saccades and at the retinotopically shifted target location immediately after saccades. This anticipatory activation helps to maintain a stable percept of the visual world. Here we use a computational scan path model, to show that peri-saccadic attention has dramatic consequences on scanpath statistics. Our modeling work is based on the SceneWalk model, which implements two processing streams: saliency-based activation and fixation-based inhibitory tagging. In combination, these streams drive a priority map for saccade target selection. Here, we extend the model by adding (a) peri-saccadic attentional shifts, (b) delayed inactivation of recently fixation regions for facilitation of return, and (c) a central fixation bias. As the model is firmly theory-based, parameter values are interpretable allow evaluation of theoretical predictions. We implemented a Bayesian framework for model inference. This approach fits the model to data without relying on ad-hoc performance metrics that might overfit the model to the specific target

effects. The results based on these statistically rigorous procedures capture both static effects and dynamic serial dependencies. The fitted extended model reproduces systematic tendencies in eye movement including saccade amplitude distributions, intersaccadic turning angles and their relation to fixation durations and saccade amplitudes, and distance-to-center behavior. Peri-saccadic attentional mechanisms are well-established both in experiments and neurocognitive theories of vision. The improvements we achieved in model results suggests that neurophysiological principles, in particular, the decoupling of fixation locations from attentional mechanisms around the time of saccade, play an important role in explaining saccade behavior.

Acknowledgements: This work is part (Project B05) of Collaborative Research Center 1294 Data Assimilation at the University of Potsdam, funded by Deutsche Forschungsgemeinschaft

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

I hope you enjoy the talk! Please find more information on the model in our preprint: https://psyarxiv.com/zcbny/

If you want to get in touch, discuss the talk, or chat, join my official presenter meeting or feel free to email me at lisa.schwetlick@uni-potsdam.de. I'll be happy to set up further zoom meetings!

Abstract ID: 700

Predictive role of supplementary eye fields for egocentric/allocentric integration

Talk Presentation - *Topic area: Eye movements: Saccades and perception*

Vishal Bharmauria[1] (bhav2501@yorku.ca), Amirsaman Sajad[2], Adrian Schütz[3], Xiaogang Yan[1], Hongying Wang[1], J. Douglas Crawford[1]; [1]Centre for Vision Research and Vision: Science to Applications (VISTA) Program, York University, Toronto, Canada, [2]Vanderbilt Vision Research Centre, Vanderbilt University, Nashville, USA, [3]Philipps University of Marburg, Marburg, Germany

The brain could encode object location either in egocentric (relative to self) or allocentric (relative to another object) coordinates. Human behavioral experiments have shown that the visual system optimally combines egocentric (ego) and allocentric (allo) cues for goal-directed action (Byrne and Crawford 2011; Klinghammer et al. 2015, 2017). However, the neural mechanisms of this phenomenon are unknown.

Recently, it was reported that the frontal eye fields (FEF) re-integrate ego and allo cues during memory and gaze motor responses following a landmark shift (Bharmauria et al. BioRxiv2019). Do the supplementary eye fields (SEF) play the same or different role? Here, we tested > 250 SEF sites in two monkeys trained on a cue-conflict delayed saccade task where the landmark (L) surreptitiously shifted during the delay (just after a visual mask presentation) and the monkey was cued to make gaze shifts toward remembered targets relative to a shifted allocentric landmark (L'). Behaviorally, the shifted landmark caused the gaze end-points to deviate about 1/3 in the direction of landmark shift. We then fit spatial models against response fields during visual, memory, and motor activity. This showed that the SEF exhibits the same fundamental egocentric transformation, i.e., target to gaze (T-G) observed previously between FEF visual and motor responses (Sajad. et al. 2015, 2016). However, the most significant allo shift (nearly halfway along T-T') occurred much earlier, just before the mask onset and landmark shift. Further, in SEF, correlated integration of egocentric (T-G) and allocentric (T-T') information occurred as early as the initial visual response, and then reappeared before and during the final motor burst. In summary, both the FEF and SEF participate in ego-allo integration for gaze. However, SEF seems to predict the future allocentric transformation (likely based on past exposure to many trials), whereas FEF incorporates the actual event into the gaze.

Acknowledgements: Canadian Institutes for Health Research, the Canada Research Chair Program (JDC), and the NSERC CREATE Brain in Action Program and VISTA / Canada First Research Excellence Fund (VB

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 977

Faces: Context, configuration

Estimating the dimensionality of face space empirically

Poster Presentation - *Topic area: Faces: Context, configuration*

Jared Pincus[1] (jpincus@stevens.edu), Jordan W Suchow[1]; [1]Stevens Institute of Technology

Learned generative models of human identity and appearance, such as those that result from training deep neural networks on large databases of face photographs, are typically high-dimensional, representing each face as a point in a space with hundreds to thousands of dimensions. However, social perception of faces is

low dimensional, relying on only a handful of key dimensions. What is the dimensionality of face space in the mind of an observer? To estimate the dimensionality, we begin with a simple observation: for any given person, there are many unrelated people who look similar to them. Consider, for example, the phenomena of "twin strangers" and "doppelgängers", where strangers look almost impossibly alike. Next, we note that the very concept of strong resemblance exists only in low dimensional spaces. When points are well-distributed in high dimensional spaces, nearest neighbors (i.e., a person and their closest doppelgänger) are nearly as far apart as randomly selected pairs of points (i.e., a person and a random stranger). By contradiction, face space must be low-dimensional. How low? Using the scaling relationship between dimensionality and nth-nearest-neighbor distances, it becomes possible to empirically estimate the dimensionality of face space by measuring the ratio of JNDs between random pairs of faces and faces paired with their nearest neighbors. In an experiment, we estimated this ratio empirically. To estimate the ratio, we first sampled a set of faces from a trained neural network (StyleGAN; Karras, Laine, & Aila, 2018). Next, we measured the distance between each pair of faces in JNDs through a psychophysical adjustment procedure. Finally, we computed the ratio of nearest-neighbor distances to random-neighbor distances. We found that the ratio, 0.76 [0.73, 0.79; 90% CI], implies a dimensionality of human face space between 7 and 12 dimensions.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1456

Face Aftereffect formation is influenced by the diversity of the training set

Poster Presentation - *Topic area: Faces: Context, configuration*

M.D. Rutherford[1] (rutherm@mcmaster.ca), Victoria Foglia[1]; [1]McMaster University, Psychology Neuroscience and Behaviour

Introduction. Although the face aftereffect phenomenon is known for face identity, age and emotion, it is unknown how the diversity of the face training set influences aftereffect formation. Observers saw a homogeneous set of distorted faces (middle-aged Caucasian males) and a diverse set of distorted faces (male and female; Caucasian, Asian, Latino and African American) during adaptation. Evidence of aftereffects was tested. Methods. 33 participants underwent an opposing aftereffects paradigm viewing a set of diverse and a set of Caucasian male faces. Participants viewed manipulated face images in one of two

adaptation conditions: 1) the diverse face set with features contracted, and the homogeneous face set with features expanded or 2) the opposite. During pretest, participants viewed 64 face pairs, one contracted by 10% and one expanded by 10% and selected which face they found more attractive. During adaptation, faces were distorted by 60%. Post-adaptation testing was identical to pre-adaptation testing. Results. Using a mean change score (contracted faces selected as more attractive before vs. after adaptation) as the dependent variable, the two adaptation conditions were significantly different ($F(1,31)=13.072$, p= <.05). Adaptation to the contracted diverse face set led to evidence of aftereffects in the expected directions ($t(31)=2.685$, p= <0.05), but the significant differences observed after adaptation to the contracted homogeneous face set was opposite of the expect direction for both conditions ($t(31)=3.061$, p= <0.05). Aftereffects were created only by adapting to the diverse face set, not the homogeneous face set. These results indicate that adapting to the diverse face set after a featural manipulation led to aftereffects for all faces (the diverse and the homogeneous face sets) in the same direction. This result suggests that diversity within a face set influenced aftereffect formation.

Acknowledgements: This research was funded by a Social Sciences and Humanities Research Council (Canada) grant to MDR.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 251

Gender- and age-contingent face aftereffects and the Hebbian normalization model

Poster Presentation - *Topic area: Faces: Context, configuration*

Seyed Morteza Mousavi[1], Ipek Oruc[1], Michael Landy[2]; [1]University of British Columbia, [2]New York University Center for Neural Science, New York University

Classical adaptation phenomena (e.g., tilt after-effect, waterfall illusion) are a response to a biased distribution of stimuli (e.g., more right-tilted adapters) and led to models involving gain adaptation (highly stimulated neurons reduce their gain). But, neurons also adapt to 2nd-order statistics (stimulus feature co-occurrence, “contingent adaptation”, Benucci et al., 2013; Aschner et al., 2018), consistent with the Hebbian normalization model (Westrick et al., 2016) in which strong co-firing of neuron pairs leads to increased mutual inhibition. This model predicts analogous behavioral effects: Co-occurring stimulus elements in an adapter lead to inhibitory effects of one on the other in perception as first tested using pairs of grating stimuli (Yiltiz et al., VSS 2018 and in press). Here, we test whether contingent adaptation, as predicted by the model, applies to adaptation to high-level perceptual features. We adapted observers (N=19) to a series of alternating old-male and young-female faces (or old-female/young-male) followed by an androgynous or a middle-aged test face. Despite the fact that there was no net first-order gender or age adaptation, we found significant age-contingent gender aftereffects (d=0.77, p=.02) biasing perception away from the adapting gender (i.e., repulsive): test faces were perceived as more masculine or feminine depending on the age of the face with which they were paired during adaptation, and analogous gender-contingent age aftereffects (d=0.63 , p=.02). Prior face adaptation work has shown figural aftereffects (e.g., eye-spacing, internal features distortion) contingent on some discrete facial attributes such as race and orientation (Rhodes et al., 2004; Jacquet, et al., 2008). Our results represent the first report of contingent aftereffects on natural face categories (i.e., age and gender) that are plausibly represented by a continuum of neurons coding for a range of values along these dimensions. The Hebbian normalization model provides an account for these contingent adaptation aftereffects in face perception.

Acknowledgements: University of British Columbia Peter Wall Institute for Advanced Studies, International Visiting Research Scholar Award (NIH EY08266) to MSL---Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant (RGPIN-2019-0555) and Accelerator Grant (RGPAS-2019-00026) to IO

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1443

Increased Configural Face Encoding Under Effortful Physical Action

Poster Presentation - *Topic area: Faces: Context, configuration*

Lilian Azer[1] (lazer001@ucr.edu), Weiwei Zhang[1]; [1]University of California, Riverside

Face recognition is critically dependent on configural and holistic processing. The present study examines the extent to which configural face processing is under top-down cognitive control using a novel dual-task paradigm in which forty participants concurrently engage in a face discrimination task and a motor task. In the Le Grand composite face discrimination task (Le Grand et al., 2004), the participants were instructed to report if the upper halves of two sequentially presented composite-face stimuli were the same or different in face identity while ignoring the consistently same bottom halves. The composite face effect (CFE) manifested as higher task performance when top and bottom halves of each face were misaligned than

when properly aligned, indicating more interference (and hence more holistic face encoding) in the discrimination of top face halves by bottom face halves. Critically, the concurrent physical effort, operationalized as 45% of the maximal voluntary contraction (MVC) versus 5% MVC exerted on an isometric hand dynamometer by individual participants, led to significantly larger CFE in accuracy, presumably due to reduced inhibition of the bottom halves of face stimuli. In contrast, the overall face recognition ability assessed using the Glasgow Face Matching Task (GFMT; Burton, White, & McNeil, 2010) showed no significant effect of the concurrent physical load. Together, these results provide further support for impairment in inhibitory control under concurrent physical effort, in line with our previous demonstrations of reduced cognitive control by concurrent physical effort (Azer et al., 2019, VSS; Cappiello et al., 2018, VSS). Follow up studies will investigate the effect of concurrent physical effort on global verses local processing in visual perception beyond face processing.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 272

Opposing Aftereffects across a Caucasian Male face set and a face set that was diverse by gender and ethnicity

Poster Presentation - *Topic area: Faces: Context, configuration*

Victoria Foglia[1] (fogliav@mcmaster.ca), M.D. Rutherford[1]; [1]McMaster University, Psychology, Neuroscience, and Behaviour

Introduction. Opposing aftereffects have been seen across groups that differ by sex and race. For example, viewing Caucasian expanded faces and Chinese contracted faces lead to opposite face aftereffects when participants subsequently viewed each set. Here we tested whether viewing Caucasian male faces and a diverse set of faces (male, female; Caucasian, Asian, Latino, African American) during adaptation would result in opposing aftereffects. Methods. 62 participants underwent an opposing aftereffects paradigm viewing a set of Caucasian male faces and a diverse face set. 31 participants viewed a contracted set of diverse faces and an expanded set of Caucasian male faces, and 31 viewed the opposite. In pre-adaptation trials, participants viewed 64 face pairs, one contracted and one expanded by 10%, selecting which they found more attractive. During adaptation, participants viewed faces altered by 60%. Post-adaptation trials were identical to pre-adaptation trials. Results. Using a mean change score (contracted faces selected before vs after adaptation) as the dependent variable, there was a significant interaction between the two

conditions (F(1,25)=7.360, p=<.05). Aftereffects were then assessed for each condition separately. For the contracted Caucasian male and expanded diverse condition, significant opposing aftereffects were observed, with a greater change in preference for the contracted diverse faces than the expanded Caucasian male faces (t(12)=-4.770, p= <0.001), consistent with adaptation. Though the scores for contracted Caucasian male and expanded diverse faces did not differ significantly (t(13)=.901, p= .384), the change was in the expected direction. These results are the first to suggest that it is possible to induce opposing aftereffects across a diverse and a homogeneous set of faces. Past research has found opposing aftereffects using face sets that are homogeneous within and distinct across face sets. These results suggest the potential of face templates that are sensitive to variance.

Acknowledgements: This research was funded by a Social Sciences and Humanities Research Council (Canada) grant to MDR.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 252

Faces: Deep neural networks

Can We Detect Face Morphing to Prevent Identity Theft?

Poster Presentation - *Topic area: Faces: Deep neural networks*

Sophie Nightingale[1] (snightingale@berkeley.edu), Shruti Agarwal[1], Hany Farid[1]; [1]University of California, Berkeley

A relatively new type of identity theft uses morphed facial images in identification documents in which images of two individuals are digitally blended to create an image that maintains a likeness to each of the original identities. We examined people’s ability to detect facial morphing. We collected 3,500 passport-format facial images. This dataset consists of a diverse set of people across gender, age, and race. Convolutional neural network descriptors are used to extract a low-dimensional, perceptually meaningful, representation of each face. For each of 54 faces, these representations are used to find the most similar face in the dataset. A mid-way morph is generated between each pair of different individuals; another mid-way morph is generated between two different photos of the same individual. The morphs are manually edited to remove obvious artifacts. In Experiment 1a (all experiments, N=100), on each trial, participants

viewed two images—an original image alongside a morph (from the same or different individual)—and indicated if they are of the same individual or not. Participants struggled to perform this task accurately and were biased to respond “same” (d’=0.68; B=1.81). In Experiment 1b we focused participants’ attention on the eye/nose/mouth regions and provided feedback on each trial. This did not improve sensitivity but led to a reduced bias (d’=0.58; B=1.09). In Experiment 2a, participants saw a single image—a morph or an original—and indicated if it was a morphed face or not. Participants performed only slightly above chance (d’=0.21; B=0.98). In Experiment 2b, when participants were informed of morphing artifacts to look out for and received feedback, performance improved slightly (d’=0.53; B=0.92). Preliminary results suggest that computational methods for face recognition may outperform humans but remain imperfect. Combined, these results suggest that face morphing might be a worryingly effective technique for committing identity theft.

Acknowledgements: This research was developed with funding from the Defense Advanced Research Projects Agency (DARPA FA8750-16-C-0166).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 223

Facial Expression Information in Humans and DCNNs

Poster Presentation - *Topic area: Faces: Deep neural networks*

Y. Ivette Colón[1] (icolon@utdallas.edu), Connor Parde[1], Carlos Castillo[2], Jacqueline Cavazos[1], Alice O'Toole[1]; [1]The University of Texas at Dallas, [2]University of Maryland

Facial expression perception in-the-wild requires an ability to see emotional signals from different views. Some facial expressions (e.g., happiness) are recognized more accurately than others (e.g., fear) from faces viewed frontally. However, results on facial expression perception from non-frontal viewpoints are limited and non-convergent (Matsumoto & Hwang, 2011; Hess et. al, 2007). We investigated expression classification over viewpoint change in an experiment that incorporated human and machine perception. The goal was to test the effects of viewpoint on expression perception, and to examine the role of the visual stimulus, via machine perception, in supporting classification. We tested expression classification for human subjects (N=160) and a deep convolutional neural network (DCNN) trained for face identification (Ranjan et al., 2018). DCNNs model ventral visual stream processing and are known to retain expression and viewpoint information about face images (Colón, et al. 2018; Hill et al., 2019). The test employed the

Karolinksa database (KDEF)—a controlled dataset of expressions containing 4,900 images of 70 actors posing 7 facial expressions (happy, sad, angry, surprised, fearful, disgusted, neutral) photographed from 5 viewpoints (90- and 45-degree left and right profiles, and frontal) (Lindqvist et al., 1998). For frontal faces, both humans and the DCNN replicate findings of better recognition of some expressions (e.g., happy > fear) (humans, $p < .001$), and equivalent classification across viewpoint. For humans, however, there was a strong advantage for detecting angry faces from the frontal viewpoint (viewpoint-expression interaction, $p < .01$). There was no such interaction in the DCNN, indicating that the human advantage for detecting angry faces from the front cannot be accounted for completely by visual features. This suggests that the high accuracy humans show for detecting angry faces from the front may be due to independent facial expression processing outside of the ventral visual stream (e.g., dorsal, subcortical).

Acknowledgements: National Eye Institute Grant 1R01EY029692-01 to A. O'T.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please feel free to email me at icolon@utdallas.edu if you have any questions. Have a great weekend!

Abstract ID: 600

Investigating the emergence of expression representations in a neural network trained to discriminate identities

Poster Presentation - *Topic area: Faces: Deep neural networks*

Emily Schwartz[1] (schwarex@bc.edu), Kathryn O'Nell[2], Stefano Anzellotti[1]; [1]Boston College, [2]University of Oxford

A picture of a face provides information about both someone's identity and their facial expression. According to traditional view, identity and expression recognition are performed by separate mechanisms. However, recent studies show that recognition of identity and expressions may not be as disjointed as originally thought: face identity can be decoded from response patterns in pSTS (Anzellotti et al. 2017, Dobs et al. 2018), a region previously implicated in expression recognition. Joint processing of expressions and identity might be driven by computational efficiency. In support of this hypothesis, O'Nell et al. 2019, found that artificial neural networks (ANNs) trained to recognize expressions spontaneously learn features that support identity recognition. Here, we investigate transfer learning in the reverse direction, testing whether ANNs trained to distinguish between identities learn features that support recognition of facial expressions. We trained a siamese architecture without handcrafted features on a face verification task.

The network achieved 77.22% accuracy. To see if the network spontaneously learns features that support expression recognition, we froze its weights and used features in its hidden layers as inputs to a linear-layer trained to label expressions. We will discuss the generalization performance from identity to expressions of simpler networks trained on a single dataset (which achieve low accuracy in both identity and expression tasks when applied to the Karolinska Directed Emotional Faces dataset), and the performance of more complex networks trained on multiple datasets.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1590

Mechanisms of Facial Tuning in a Brain-inspired Deep Network

Poster Presentation - *Topic area: Faces: Deep neural networks*

Amirhossein Farzmahdi[1], Reza Ebrahimpour[2,1], Winrich Freiwald[3]; [1]School of Cognitive Sciences (SCS), Institute for Research in Fundamental Sciences (IPM), Tehran, Iran, [2]Department of Computer Engineering, Shahid Rajaee Teacher Training University, Tehran, Iran, [3]Laboratory of Neural Systems, The Rockefeller University, New York, NY, USA

Primates can recognize faces easily and rapidly despite changes in distance, illumination, head orientation, and even partial occlusion. To determine the neural and computational mechanisms of this ability, a model system devoted to the processing of faces has proven particularly useful. This network in the macaque brain consists of multiple interconnected face areas, each highly selective for faces, but each tuned to faces in qualitatively and quantitatively different ways. Some recent computational models of face-processing have succeeded in describing the main functional properties of this network, the tuning to faces (versus objects) and the tuning to head orientation. However, it remains unclear how tuning to head orientation is generated. Here we test the hypothesis that selectivity for local facial features might be the underlying cause. We presented monkey faces and non-face objects isolated on a plain background to Alexnet, a feedforward hierarchical structure, trained with stochastic gradient descent on the ImageNet database. We then characterized feature selectivity in face-selective model units by determining the area of the input image affecting their response and we measured the unit's first-order receptive field (RF). We found that there are highly face-selective and head-orientation tuned units from the first convolutional layer onward. Our results suggested that head-orientation tuning is the direct consequence of local feature tuning. In early layers, eye-related features in frontal views and nose-related features in profile views were

particularly abundant among critical facial features. Coverage of eyes and nose parts increased along the hierarchy. Thus we found that in Alexnet, local feature tuning is a sufficient mechanism for generating head-orientation tuning. We will discuss the relationship of this mechanism in a deep convolutional network with the properties found in the macaque face-processing system.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1463

Physiologically-inspired models for the recognition of dynamic facial expressions

Poster Presentation - *Topic area: Faces: Deep neural networks*

Michael Stettler[123] (michael.stettler@cin.uni-tuebingen.de), Tahereh Azizpour Lindy[1], Nick Taubert[12], Martin Giese[123]; [1]Compsens, [2]Department of Cognitive Neurology, CIN & HIH, [3]International Max Planck Research School for Intelligent System

The recognition of dynamic facial expressions crucial for the social communication in primates. However, the underlying detailed neural circuits remain unclear, and relevant neurophysiological data is just being gathered now. Different computational mechanisms might account for the processing of dynamic facial expressions, which are inspired by mechanisms known from the processing of dynamic body stimuli and static faces. We present two fundamentally different neural models for the recognition of dynamic faces that imply quite different behaviors of dynamic face-selective neurons at the single-cell level. METHODS: Both models are hierarchical neural network models that process video sequences. The lower levels of the models consist of a hierarchy of feature detectors, either from a physiologically-inspired model of the visual pathway or implemented as deep neural network model (VGG16). The highest levels of the models are fundamentally different. One model uses shape detector neuros, trained with key frames from movies. These neurons are embedded in a recurrent neural network model that makes their responses sequence-selective. Models of this type account for details of single-cell data of hand- and body motion selective neurons. The second model exploits a norm-referenced encoding mechanism with neurons that represent difference vectors in feature space between the neutral face and the extreme frames of the encoded expressions. The firing rate of these neurons varies continuously with expression strength. This encoding mechanism has been shown to account for the identity tuning of face-selective neurons in monkey area IT. Adding an output mechanism with differentiator neurons that respond to changes of the output of such

expression-encoding neurons, accounts for selectivity for dynamic expressions. RESULTS: Both mechanism are suitable to distinguish facial expressions of humans and monkeys. They make different predictions for stimuli that morph between neutral and highly expressive movements, which can be compared to the results of ongoing recordings.

Acknowledgements: HFSP RGP0036/2016, EC H2020 CogIMon ICT-23-2014 /644727, BMBF FKZ 01GQ1704, KONSENS-NHE BW Stiftung NEU007/1, NVIDIA Corporation

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 668

Region-of-Interest MRI datamining with Deep Convolution Neural Network Class Activation Map in Prosopagnosics and Traumatic Brain Injury

Poster Presentation - *Topic area: Faces: Deep neural networks*

Jirapat Likitlersuang[1,2,3] (likitlersuang@hms.harvard.edu), David Salat[1,2], Regina McGlinchey[1,2], Tara Galovski[2,4], Kimberly Werner[3], Joseph DeGutis[1,2]; [1]Harvard Medical School - Harvard University, [2]VA Boston Healthcare System, [3]Missouri Institute of Mental Health, University of Missouri – St. Louis, [4]Boston University School of Medicine, Boston University

Structural and functional MRI (s/fMRI) are extremely useful methods to measure brain structure and function non-invasively. Unfortunately, review studies have suggested that many s/fMRI studies have poor reproducibility and poor ability to infer causal mechanisms. This limitation is contributed by the high complexity and high Signal-to-noise ratio of MRI data. In recent years, the advancement in Deep Convolution Neural Networks (DCNN) have seen an exponential growth in research on large datasets resulting in increasing number of real-world applications. The advantages of DCNN are the ability to recognize and learn relevant features in complex datasets. This is opposed to traditional machine learning methods which involve manual decision making, particularly in feature selection and analysis. However, due to the architectural inability to explain the decision-making processes, DCNN is often refers to as "black box". One way to overcomes this limitation is to implement a Class Activation Map (CAM). Unlike traditional CNN, CAM network keeps the spatial information, which in turn allows extraction of activation maps (a map of Region-of-Interest, ROI, that the network deems critical in the classification). In this study,

CAM networks were developed for s/fMRI scan where it was trained to classify clinical/neurological grouping. Activation maps were extracted from a structural T1 scans and quantitative MRI of 21 developmental prosopagnosics (DP) and 17 healthy controls. The accuracy at classifying DP vs. healthy based on leave-one-participant-out was 66%. Similarly, we also validated this approach on structural T1 and resting state fMRI comparing 40 individuals with history of Traumatic Brain Injury (TBI) to 40 matched controls without TBI. This analytical method will allow automated as well as meaningful and robust data mining of large datasets, which is ideal for s/fMRI application.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1373

Seeing Through De-Identified Faces in Videos by Humans and a Deep Convolutional Neural Network

Poster Presentation - *Topic area: Faces: Deep neural networks*

Asal Baragchizadeh[1] (axb137130@utdallas.edu), Kimberley D. Orsten-Hooge[1], Thomas P. Karnowski[2], David S. Bolme[2], Regina Ferrell[2], Parisa R. Jesudasen[1], Carlos D. Castillo[3], Alice J. O'Toole[1]; [1]The University of Texas at Dallas, [2]Oak Ridge National Laboratory, [3]University of Maryland

The increasing use of cameras in public spaces raises privacy concerns that have spurred the development of face de-identification methods. These methods are aimed at obscuring identity, while preserving facial actions. We evaluated the performance of eight face de-identification algorithms in naturalistic driving data. Humans and a pre-trained, high-performing deep convolutional neural network (DCNN) (Ranjan et al., 2018) were tested on their ability to "see through" the identity-masking methods. De-identification algorithms included a personalized supervised bilinear regression method for facial action transfer, a generic avatar face, four edge-detection methods, and two combined masking approaches. In an old/new recognition experiment, humans ($n = 160$) learned driver identities from high-resolution images and were tested with drivers in low-resolution videos. Faces in the videos were either intact or masked with one of the algorithms. Identification accuracy was lower in masked conditions ($p < .001$); (intact-face, $d' = 1.11$; minimums: Canny edge-detection and avatar, $d' = .17$ and $.16$, respectively). Subjects exhibited conservative decision bias for all videos (maximum: avatar, $C = .74$; minimum: Canny-inverted edge-detection, $C = .18$). Next, the DCNN was tested with the high-resolution images and frames extracted from

videos. The output of the penultimate layer of the network served as a driver's face representation. For each video, we created a driver identity template by averaging DCNN face representations across frames. Identification was measured as the cosine between the face representation vectors. Performance was tested between high-resolution images and each of the masked and unmasked video templates. The DCNN performed surprisingly well across conditions, given the challenging viewing conditions. Across conditions, there was general accord in the pattern of performance for humans and machines, with the best (unmasked) and worst (Canny edge-detection and avatar) conditions aligning. We propose that humans and machines should both be utilized for evaluating de-identification methods.

Acknowledgements: US Department of Energy - DE-AC05-00OR22725. Oak Ridge National Laboratory, CDC was supported by IARPA - 2014-14071600012.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 757

Using task-optimized neural networks to understand why brains have specialized processing for faces

Poster Presentation - *Topic area: Faces: Deep neural networks*

Katharina Dobs[1] (kdobs@mit.edu), Alexander JE Kell[2], Julio Martinez[1], Michael Cohen[1,3], Nancy Kanwisher[1]; [1]Massachusetts Institute of Technology, [2]Columbia University, [3]Amherst College

Category-selective regions are a prominent feature of the ventral visual pathway. Why is there specialization for some categories (e.g., faces, scenes), but not others (e.g., food, cars)? And why does functional specialization arise in the first place? Here, we used deep convolutional neural networks (CNNs) to test the hypothesis that face-specific regions are segregated from object regions because face and object recognition require different representations and computations. We trained two separate AlexNet networks to categorize either faces or objects. The face-trained CNN significantly outperformed the object-trained CNN on face categorization on held-out identities and vice versa, demonstrating that the representations optimized for one task are suboptimal for the other. To determine whether representations could be learned to simultaneously support both tasks, we trained dual-task CNNs with a branched architecture, varying the number of layers that were shared between face and object tasks (i.e.,

early vs. late branch points; Kell et al., 2018). We found that dual-task networks sharing late layers performed worse than CNNs trained on only faces or only objects. However, dual-task networks sharing only early processing stages, presumably like the primate visual system, showed no cost of sharing. Do these results generalize to architectures with larger capacity? We trained VGG16 networks on the same tasks. Surprisingly, in this case, even the fully-shared dual-task CNN performed as well as the separate networks. However, lesion experiments showed that segregation of face and object processing had emerged spontaneously in the dual-task network. Critically, a dual-task network optimized for food and object categorization showed less task segregation. These results suggest that functional specialization in the brain exists for faces but not for food because food and object categorization can be performed by relying on common representations while face and object recognition rely on inherently different computations.

Acknowledgements: This work was supported by a Feodor Lynen Fellowship of the Humboldt foundation to K.D., NIH grant Grant DP1HD091947 to N.K and National Science Foundation Science and Technology Center for Brains, Minds, and Machines.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 660

Faces: Development and disorders

Characterizing a perceptually impaired subtype of developmental prosopagnosia: the eyes have it.

Poster Presentation - *Topic area: Faces: Development and disorders*

Maruti Mishra[1,2] (maruti_mishra@hms.harvard.edu), Regan Fry[1,2], Joseph DeGutis[1,2]; [1]Department of Psychiatry, Harvard Medical School, Boston, USA, [2]Boston Attention and Learning Laboratory, VA Boston Healthcare System, Boston, USA

Apperceptive and associative acquired prosopagnosia (AP) subtypes have often been reported, but it has been challenging to apply this distinction to developmental prosopagnosia (DP). One reason is that

methods of categorizing perceptually impaired DPs have been insufficient, e.g., using single tests for classification. In this study, we compared accuracy performance between 30 DPs and 30 age-matched controls on a battery of four valid/reliable face matching tests: Benton Face Recognition Test, USC Face Perception Test, Telling Faces Together test, and Cambridge Face Perception Test. Using DSM-5 cutoffs for mild neurocognitive impairment, DPs >1SD below the mean on two or more of the above tests were classified as perceptually impaired (16/30 DPs), while the remainder (14/30) were classified as perceptually unimpaired. To see if there were meaningful differences between these DP sub-groups, we further assessed performance on face tasks that measured feature and configural processing. On the Georges face-matching task, DPs with perceptual impairment showed significantly reduced performance for identifying changes in the upper half of the face (eye position and forehead height) but not in the lower half of the face (mouth size and chin). In the part-whole test, perceptually impaired DPs showed significantly worse performance on eyes trials while performing similarly on the mouth and nose trials. Thus, similar to apperceptive APs, perceptually impaired DPs had particular impairments with processing the eye region. Poorer performance in perceptually-impaired DPs was also observed on the CFMT and face familiarity parameter on the Old/New task, overall suggesting that perceptually-impaired DPs are also worse at face recognition and that this may be driven by a lack of ‘feeling of knowing’ that is relatively intact in perceptually unimpaired DPs. Our study provides a novel, theoretically-grounded approach to identifying perceptually impaired DPs and provides evidence of important mechanistic differences that are consistent with the AP literature.

Acknowledgements: Supported by the National Eye Institute of the National Institutes of Health under Award Number R01EY026057.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

You can contact me maruti_mishra@hms.harvard.edu
Abstract ID: 1319

Abstract ID: 1319

Faces are no object: Normal novel object performance in developmental prosopagnosia

Poster Presentation - *Topic area: Faces: Development and disorders*

Regan Fry[1], Xian Li[1], Jeremy Wilmer[2], Joseph DeGutis[1]; [1]Harvard Medical School, [2]Wellesley College

The classic debate over the face specificity of prosopagnosia was recently revived by a meta-analysis that found 42-80% of developmental prosopagnosics (DPs) to have mild to major object recognition deficits (Geskin and Behrmann, 2017). However, nearly all studies used real-world objects (e.g., cars) where recognition depends on object-specific expertise, raising the question of whether impairment in a single object category is representative of general object abilities. Recently, recognition tests using novel objects have shown to correlate highly with general object abilities. No studies to our knowledge have tested DPs using novel object memory tests (NOMTs), and the majority of studies have tested fewer than 20 DPs. In the current study, we tested 30 DPs and 30 age- and gender-matched controls (TD) on a NOMT ("Ziggerins") and the Cambridge Face Memory Test (CFMT). DPs were impaired on the CFMT (DP: 38.3, TD: 59.4, $p<0.01$) but performed normally on the NOMT (DP: 58.2, TD: 57.5, $p=0.75$). We also compared DP NOMT performance to a matched sample of 275 web-based controls and found no difference in reaction time (DP: 4.2, TD: 4.1, $p=0.58$) and only a trend in accuracy difference (DP: 58.2, TD: 61.1, $p=0.06$). Additionally, 12 out of the 30 DPs met the stringent criteria for a classical dissociation between face and object recognition. These results are consistent with our fMRI findings in a subset of 23 DPs and 23 controls, which showed reduced face-selectivity in DPs across all face areas, but no difference for the object-selectivity between the two groups. Taken together, these results suggest that DPs are essentially normal at novel object recognition. Future investigations would be useful to determine whether some DPs have specific impairments with acquiring longer-term object expertise.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1231

Processing of Facial Expressions in Developmental Prosopagnosia

Poster Presentation - *Topic area: Faces: Development and disorders*

Shivani Goyal[1], Hannah Wild[1], Sarah Herald[2], Brad Duchaine[2], Leslie G. Ungerleider[1], Shruti Japee[1]; [1]Laboratory of Brain and Cognition, NIMH, NIH, [2]Department of Psychological and Brain Sciences, Dartmouth University

Developmental prosopagnosia (DP) is a condition characterized by impairments in facial recognition. A prominent theory of face perception posits that facial identity and facial expression processing have distinct functional pathways (Bruce & Young, 1986; Haxby, Hoffman, & Gobbini, 2000), such that the superior temporal sulcus is thought to process the dynamic aspects of a face such as facial expressions, while the fusiform face area is thought to process invariant facial features such as identity. DP has previously been used as a model to test this theory (Duchaine, Parker & Nakayama, 2003; Biotti & Cook, 2016). However, these studies have been limited to static stimuli, suggesting the need to systematically characterize emotion recognition in individuals with DP using dynamic stimuli. In the present study, we first tested individuals with and without DP on an emotion detection task utilizing static faces with varying levels of emotional expressions. Specifically, we morphed neutral faces with angry, happy, and fearful expressions to create a spectrum of emotional content within faces. On each trial, participants were asked to indicate if the face displayed a happy, fearful, angry, or neutral expression. In a separate perceptual control task, participants indicated if the face displayed an open or closed mouth. We hypothesized that individuals with DP would show similar detection thresholds as controls on our emotion detection and control tasks. Four individuals with DP and seven control subjects completed both tasks. Preliminary results indicated that individuals with DP have similar thresholds as controls for detection of happiness and fear, but slightly higher thresholds for anger. In addition, individuals with DP performed similarly to controls on the perceptual control task. These results suggest that DPs may have subtle deficits in facial expression processing. Additional ongoing studies using dynamic faces and body expressions will further characterize emotion processing in developmental prosopagnosia.

Acknowledgements: NIMH Intramural Research Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1166

Use of Reverse Correlation to Reveal Body Image Disturbance Association with Orthorexia Nervosa

Poster Presentation - *Topic area: Faces: Development and disorders*

Adrianne Pauzé[1] (paua07@uqo.ca), Marie-Pier Plouffe-Demers[1,2], Justine Goulet[1], Hana Furumoto-Deshaies[1], Daniel Fiset[1], Dave Saint-Amour[2], Caroline Cyr[3], Caroline Blais[1]; [1]Universite du Quebec en Outaouais, [2]Universite du Quebec a Montreal, [3]Centre Hospitalier Pierre Janet

Orthorexia nervosa (ON), described as a pathological obsession with healthy eating (Dunn & Bratman, 2016), still presents no consensual definition, notably in regard to body image disturbance. This study applied the psychophysical method of Reverse Correlation (Mangini & Biederman, 2004) to verify if ON symptomatology, measured with the Eating Habit Questionnaire (Gleaves et al., 2013), is associated with body image dissatisfaction and/or misperception. Validity of Reverse Correlation for body image measurements was also verified by comparing it to a self-report questionnaire (Cash, 2000). Reverse Correlation allowed to reveal participants mental representation (MR) of their current (task 1) and ideal (task 2) body images. Every trial (500/task), participants (n=68) viewed two stimuli depicting their own body overlaid in white sinusoidal noise. They had to decide which one was the most similar to their current (task 1) or ideal (task 2) body. Classification images representing MR of their current and ideal body were calculated by averaging all noise patches that were added to selected stimuli. Body misperception corresponded to the difference between real body and MR of current body; and body dissatisfaction to difference between MRs of current and ideal body. To measure these differences, independent groups (n=64) compared images on their level of fat (group 1), and muscularity (group 2). Body misperception and dissatisfaction scores obtained with Reverse Correlation correlated with the self-report measure (r=.242 to .535, p=.000 to .054), supporting its use to assess body image disturbance. ON correlated with body fat dissatisfaction with whole body, arms/shoulders, chest/breast, abdomen, hips, thighs, and muscularity dissatisfaction for chest/breast and hips (r=.238 to .314, p=.009 to .051). ON also correlated with muscularity misperceptions for arms/shoulders (r=.236, p=.053) and abdomen (r=.238, p=.051). ON was not related to body fat misperceptions (all p’s>.148). These results suggest that body image disturbance is part of orthorexia features.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 238

Faces: Expressions

A bias to underestimate pain is linked with mental representations of pain facial expressions

Poster Presentation - *Topic area: Faces: Expressions*

Caroline Blais[1] (caroline.blais@uqo.ca), Alexandra Lévesque-Lacasse[1], Carine Charbonneau[1], Marie-Claude Desjardins[1], Daniel Fiset[1], Stéphanie Cormier[1]; [1]Université du Québec en Outaouais, Canada

Evaluating the pain experienced by someone else is a skill of high social and biological importance. Interestingly, underestimation bias in pain judgments are often observed. The present study aims at investigating the way an observer has encoded the appearance of facial expressions of pain in visual memory as one potential perceptual source for this bias. The mental representation of pain facial expressions was extracted in 49 participants using Reverse Correlation (Mangini & Biederman, 2004). On each trial, a base face embedded in white sinusoidal noise was presented, and participants were asked to judge, on a scale from 0 to ten, the degree to which it expressed pain. Participants were then presented with videos of individuals experiencing different levels of pain, after which they were asked to evaluate their pain. A region-of-interest analysis was then conducted to measure the salience with which three core facial features associated with pain expressions were coded in the mental representations (i.e. eyes narrowing, brow lowering, nose wrinkling/upper-lip raising). A correlation between the saliency of these three features and the underestimation bias of each participant was then calculated. The results confirm the presence of an underestimation bias in our sample ($t(48)=-8.5$, $p<.001$) and replicate previous findings showing that brow lowering and nose wrinkling/upper-lip raising are given more weight than eye narrowing in the average mental representation (Blais et al., 2019). The underestimation bias was also significantly correlated with the saliency of the brow lowering ($r=0.32$, $p=.03$) and the nose wrinkling/upper-lip raising ($r=-0.44$, $p=.002$) features, but not with the saliency of eye narrowing ($r=-0.10$, $p=.48$). Overall, these results indicate that perceptual factors may underlie the underestimation bias. Individuals that encode pain expressions by giving more importance to nose wrinkling/upper-lip raising than brow lowering show a higher tendency to underestimate the pain experienced by others.

Acknowledgements: Supported by a grant from the Social Sciences and Humanities Research Council (SSHRC) to Caroline Blais, Daniel Fiset, and Stephanie Cormier, and by an undergraduate scholarship from the Natural Sciences and Engineering Research Council of Canada (NSERC) to Alexandra Lévesque-Lacasse.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1550

Cross-species representations of dynamic facial expression

Poster Presentation - *Topic area: Faces: Expressions*

Nick Taubert[1,2] (nick.taubert@klinikum.uni-tuebingen.de), Michael Stettler[1,2,3], Ramona Siebert[2], Silvia Spadacenta[2], Peter Dicke[2], Hans-Peter Thier[2], Martin A. Giese[1,2,3]; [1]Section Computational Sensomotorics, [2]Department of Cognitive Neurology, CIN & HIH, University Clinic, [3]International Max Planck Research School for Intelligent System, Tuebingen Germany

Primates' facial expressions represent an important channel of emotional communication. Human and monkey expressions of the same emotion can be quite different. How efficiently can we learn to recognize facial expressions of another primate species, and can we understand human facial movements, even if they are linked to faces of another species? METHODS: To clarify these questions, exploiting state-of-the-art technology in computer animation, we have developed highly realistic models of dynamically moving macaque and human heads. These faces were animated using human and monkey motion capture data. Using a hierarchical generative Bayesian model (combining GP-LVMs and GPDMs), we interpolated continuously in space-time between the facial movements representing emotional expressions in humans and monkeys. In addition, this technique allows to modify continuously the expressiveness of such facial movements. Exploiting these stimuli, we categorized facial movements from a two-dimensional morphing space, including two expressions from humans and monkeys in terms of expression and species. Movements were presented on the monkey and the human face model. RESULTS: Representation of facial movement was largely independent of the basic form of the face (human or monkey). For natural expressions we found no own-species advantage in the categorization, but instead higher expressiveness of the monkey expressions. This effect is diminished if stimuli are balanced in terms of expressiveness by equating their optic flow content. This supports a joint perceptual representation for dynamic expressions from different species with a separate encoding of the basic shape of the face and its motion. Also, it suggests a critical role of optic flow in the processing of dynamic facial expressions.

Acknowledgements: HFSP RGP0036/2016, EC H2020 CogIMon ICT-23-2014 /644727, BMBF FKZ 01GQ1704, BW Stiftung NEU007/1, KONSENS-NHE.. NVIDIA Corporation

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1067

Emotion Categories are Represented by a 2-Dimensional Valence-Arousal Space

Poster Presentation - *Topic area: Faces: Expressions*

Meng Liu[1] (2341890l@student.gla.ac.uk), Robin A.A. Ince[2], Chaona Chen[1], Oliver G.B. Garrod[1], Philippe G. Schyns[1,2], Rachael E. Jack[1,2]; [1]School of Psychology, University of Glasgow, 62 Hillhead Street, Glasgow, Scotland G12 8QB, United Kingdom, [2]Institute of Neuroscience and Psychology, University of Glasgow, Scotland G12 8QB, United Kingdom

A long-standing debate in the field of facial expressions is whether expressions of emotion are perceived as discrete categories – e.g., happy, surprise, fear, disgust, angry and sad – or according to a lower-dimensional set of continuous variables such as valence and arousal. This unresolved debate continues to hinder knowledge advances on the fundamental nature of facial expression perception. Here, we address this debate by showing that a 2D valence-arousal space of face movements accurately represents discrete emotions. First, we built a 2D valence-arousal space of face movements. We asked forty participants to rate the valence and arousal (on a 5-point Likert scale) of 1,200 facial animations composed of randomly sampled face movements (Action Units – AUs). We ascribed the face movements to the 2D (5 x 5) coordinates of their valence and arousal ratings (see Fig S1). Next, we mapped the six classic emotion categories (using 60 models for each, Jack et al., 2012), by correlating their movements with those of the 5 x 5 coordinates of the 2D valence-arousal space. This showed that emotion categories mapped onto distinct valence-arousal regions. Finally, we validated the positions of the emotion categories in valence-arousal space. We asked 20 new participants (10 females, mean age = 22.6 years) to rate the valence, arousal and emotion category of 1,200 new random facial animations. The analyses revealed that the emotion categories map onto similar regions on the valence x arousal space of face movements. Together, our results show that a 2D valence-arousal space of face movements can accurately represent discrete emotion categories and thereby bridge the gap between opposing dimensional and categorical theories of facial expression perception.

Acknowledgements: This work was supported by the European Research Council Starting Grant (ERC-2017-STG-759796) awarded to Rachael Jack and China Scholarship Council (CSC201706070134)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1224

Emotional valence mediates attention to illusory facial features in rhesus monkeys

Poster Presentation - *Topic area: Faces: Expressions*

Amanda Patterson[1] (amanda.patterson@nih.gov), Jessica Taubert[2], Reza Azazdi[3], Susan G Wardle[4], Arash Afraz[5], Leslie G Ungerleider[6]; [1]National Institute of Mental Health

Face pareidolia is the common misperception of illusory facial features in otherwise inanimate objects. Previously we showed that rhesus monkeys (Macaca mulatta) perceive illusory faces in the same images that humans do, using a free-viewing paradigm in which pairs of visual stimuli were presented to subjects (Taubert et al., 2017, Current Biology). The aim of this study was to test the hypothesis that emotional valence will mediate the attention of monkeys to different illusory faces. To this end, we created a stimulus set whereby each example of an illusory face was matched to both a monkey face, in terms of its expression (e.g. low valence = neutral expressions and high valence = aggressive or fearful expressions), and a non-face object, in terms of its object identity (e.g. a pie, a bell pepper, or a flower). Thirty stimuli were presented to two monkeys in pairs. There were three trial types containing the following stimulus pairs: Face / Illusory Face trials, Face / Non-Face Object trials, and Illusory Face / Non-Face Object trials. These trial types were presented to the subjects in a random order. The results revealed that when the monkeys were presented Face / Non-Face Object trials, the emotional valence of the face did not systematically alter viewing behavior. In both the high and low valence conditions the subjects tended to first, more frequently, and for longer periods of time look at the conspecific faces. In contrast, the emotional valence of the illusory faces in the Illusory Face / Non-Face Object trials did alter viewing behavior. When the illusory faces depicted aggressive or fearful emotional expressions, they summoned more attention (i.e. an increased number of fixations) than when they depicted neutral facial expressions. These results indicate that the emotional cues conveyed by illusory faces modulate the free-viewing behavior of monkeys.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1329

Expression in human and illusory faces (pareidolia) shows cross-domain serial dependence: evidence for common processing

Poster Presentation - *Topic area: Faces: Expressions*

David Alais[1] (david.alais@sydney.edu.au), Yiben Xu[1], Susan Wardle[2], Jessica Taubert[2]; [1]The University of Sydney, Australia, [2]The National Institute of Mental Health, USA

Recent data from primates suggests illusory faces (face pareidolia) and real faces are processed by common mechanisms. We use a serial dependence approach in human observers to test whether pareidolia and face images cross-prime each other for expression. Forty pareidolia and 40 face images spanning four levels of expression from negative (angry) to positive (happy) were selected from a pre-rated image-set. Presentation time was 250 ms and observers rated expression by clicking on a scalebar. Face condition: 40 faces presented 20 times each in random order. Pareidolia condition: 40 x 20 pareidolia images in random order. Cross-domain condition: 80 images (faces+pareidolia) presented 20 times in randomly interleaved order. Ratings for each face were combined into a mean expression for that face. Mean expression ratings for faces and pareidolia validated the pre-experiment ratings and clustered into 4 evenly spaced expression levels. To test for serial bias, the rating on the previous trial was subtracted from the current-trial's mean rating. Serial independence would yield no systematic bias, yet both image categories produced a positive serial dependence: current trial ratings were biased towards the preceding trial's expression rating. This was true for faces and for pareidolia, although the serial dependence was stronger for pareidolia. In the cross-domain condition with randomly interleaved image categories, the serial analysis was run separately for sequences where a face followed pareidolia and where pareidolia followed a face. Both orders of cross-domain sequences produced a significant positive dependence for expression. These results show that face pareidolia can be systematically and reliably rated for expression, comparably to ratings of real faces, and that face or pareidolia image sequences both exhibit a serial dependence for expression. Finally, interleaving both image types produces a clear cross-domain serial dependence and therefore implies common processing of human and illusory faces.

Acknowledgements: Support by the Australia Research Council, grant DP19010537

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1748

Face movements temporally decouple the transmission of emotion category and intensity information

Poster Presentation - *Topic area: Faces: Expressions*

Chaona Chen[1] (chaona.chen@glasgow.ac.uk), Daniel S. Messinger[3], Yaocong Duan[1], Robin A.A. Ince[2], Oliver G.B. Garrod[2], Philippe G. Schyns[1,2], Rachael E. Jack[1,2]; [1]School of Psychology, University of Glasgow, Scotland, UK, [2]Institute of Neuroscience and Psychology, University of Glasgow, Scotland, UK, [3]Department of Psychology, University of Miami, USA

Identifying the intensity of other people's emotions is critical for effective social interaction because it substantially influences adaptive responses. Although humans regularly use facial expressions to communicate variations of emotional intensity, it remains unknown what specific face movements convey this fundamental social information. Here, we address this knowledge gap using a data-driven approach that combines a novel face movement generator, reverse correlation and subjective perception to model the specific face movements that drive perceptions of high emotional intensity in the six classic emotions – 'happy,' 'surprise,' 'fear,' 'disgust,' 'anger' and 'sad.' On each experimental trial, we generated a random facial animation by randomly sampling a set of individual face movements called Action Units (AUs) and assigning random temporal dynamics (e.g., acceleration, peak latency) to each AU. Each of 60 participants (Western, 31 female, mean age = 22 years) categorized the facial animation according to one of the six emotions and rated intensity on a 5-point scale ('very weak' to 'very strong'), and completed 2400 such trials. Following the experiment, we measured the relationship between the face movements presented on each trial and the participants emotion and intensity responses using an information-theoretic analysis of Mutual Information. Our results revealed that a specific sub-set of face movements convey emotional intensity across the six emotions, characterized by expansion face movements (e.g., Mouth Stretch, AU27) amongst positive and negative emotions, and contraction face movements (e.g., Nose Wrinkler, AU9) exclusively amongst negative emotions. We further observed this pattern in a broader set of 18 complex emotions (e.g., shame, embarrassed, excited), thereby validating our results. Here, we identify for the first time the specific face movements that convey emotional intensity, and show that this fundamental social information is signaled using a latent expressive pattern of expansion and contraction face movements.

Acknowledgements: The European Research Council (FACESYNTAX; 75858), Economic and Social Research Council (ES/K001973/1 and ES/K00607X/1), British Academy (SG113332) supported this work.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

I will present my work via Zoom on June 20th at 14:00 BST time (9:00 EST time) and at 20:00 BST time (15:00 EST time). Wellcome attend my presentations! If you have questions or comments, also feel free to contact me via email: Chaona.Chen@Glasgow.ac.uk

Abstract ID: 686

Judging the emotion of natural groups

Poster Presentation - *Topic area: Faces: Expressions*

Susan Hao[1] (susanhao@berkeley.edu), David Whitney[1], Sonia Bishop[1]; [1]UC Berkeley

It has been argued that humans use summary statistics to rapidly judge group emotion. Studies have mainly used faces with posed expressions presented without context. Here, we used natural images and dimensional ratings of emotion (valence, arousal, and dominance) to investigate the influence of average emotion, maximal emotion, and context on judgments of group emotion. Stimuli contained three to five faces. Separate groups of participants viewed 1) the original images, 2) individual faces taken from the original images, and 3) context only (the image with faces removed). Stimulus ratings were averaged across participants. We conducted regression analyses with ratings of group emotion for the original image condition as the dependent measure. For valence, the arithmetic mean of individual face ratings explained the highest amount of unique variance in the ratings of group emotion with inclusion of context ratings increasing explained variance. For dominance, context explained the highest amount of unique variance. Including either the arithmetic mean or ratings of the most dominant face increased explained variance. For arousal, the maximally arousing face explained the highest proportion of unique variance in the group emotion rating; here context also made an additional significant contribution. We ran two additional conditions, one comprised the faces from the original image with context removed but position maintained; the second inserted new faces into these positions. For valence and dominance, the arithmetic mean, alone, explained significant variance in ratings of group emotion. For arousal, both the arithmetic mean and ratings of the maximally arousing face explained significant unique variance. These findings suggest that when we judge the emotion of a natural group, our relative reliance on mean versus maximal facial emotion and the extent of the role played by contextual information varies with the aspect of emotion concerned.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
21 June, 6:00 pm EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 613

Perceptual serial dependence matches the statistics in the visual world

Poster Presentation - *Topic area: Faces: Expressions*

Zhimin Chen[1] (chenzhimin@berkeley.edu), David Whitney[1]; [1]University of California, Berkeley

The ability to recognize other's emotions is critical for social interactions. Despite constant fluctuations in visual signals, we perceive emotions to be relatively stable over time. Recent studies demonstrate that serial dependence may contribute to this: the perception of facial expressions is systematically biased towards recently seen similar expressions. To the extent that there are physical autocorrelations in the world, this serial dependence could be adaptive. Here, we used natural movies to measure autocorrelations in physical displays of emotion, and we measured serial dependence in perception using the same stimuli. Observers rated the emotions of target characters in 4057 static frames extracted from video clips of Hollywood movies and documentaries. Frames from different videos were shuffled and presented to each observer in a random order, such that visual stimuli in consecutive trials were independent. Observers were asked to report the valence and arousal of the character in each trial. We found that emotion ratings in the current trial were significantly pulled by the emotions seen in previous trials, despite the fact that the sequence of images was random. Further analysis showed that the emotion seen up to 10 or more seconds in the past influenced current emotion judgments. To test whether this effect of serial dependence in perception is associated with the intrinsic autocorrelations in natural stimuli, we quantified the physical autocorrelation of emotion in our videos. We found significant autocorrelations in the displayed emotions in the movies and documentaries, and they remained significant for lags up to 10 or more seconds. This temporal tuning is similar to that of perceptual serial dependence. These results suggest that continuity fields introduce serial dependence in perception that matches the physical autocorrelations in the world, which could facilitate the stability of emotion perception.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 619

Spatial frequencies for detection of pain facial expressions revealed by reverse correlation

Poster Presentation - *Topic area: Faces: Expressions*

Joel Guerette[1,2] (joel.guerette@uqo.ca), Isabelle Charbonneau[1], Francis Gingras[1,2], Caroline Blais[1], Stephanie Cormier[1], Daniel Fiset[1]; [1]Universite du Quebec en Outaouais, [2]Universite du Quebec a Montreal

The ability to detect pain facial expressions is a crucial step before help can be provided. Because of the biological importance of this skill, it is plausible to expect that an observer can detect that expression even from a relatively large distance. Accordingly, in VSS2019, we presented a study showing that pain facial expression detection relies on low spatial frequencies (SF; Guérette et al., 2019); low SF are available from farther away than high SF. These results were obtained using posed facial expressions, with a method that involves repeating the same stimuli. In the present study, we used Reverse Correlation (Mangini & Biederman, 2004) to verify in which SF the mental representation of pain facial expressions are encoded. This method has the advantage of revealing the expectations about the appearance of an expression, and the latter may be closer to spontaneous expressions encountered in day-to-day social interactions. On each trial, a neutral face was used as background stimulus, on which sinusoidal white noise was added. Participants were asked to choose which of two noisy faces better represented a target emotion. Three target emotion conditions were used: pain, fear, and happiness. Fear and happiness are respectively considered the most similar and dissimilar expressions to pain (Wang et al., 2015). Mental representations of pain involved SF ranging from 1.13 to 12.3 cycles per face (cpf), peaking at 3.78 cpf. Fear and happiness relied on a similar range of SF (4.17 and 3.63 cpf, respectively). These results show that low SF are encoded in mental representations of pain facial expressions. This finding is congruent with previous findings that accurate detection of pain relies on low SF, and add evidence to the idea that pain expressions are communicated in a way to be detected from far away and using coarse visual information.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1384

The impact of lighting on the categorization of facial expressions

Poster Presentation - *Topic area: Faces: Expressions*

Paul Moon[1] (paul.e.moon@emory.edu), Evangelia Diplas[2], Anusha Kheraj[3], Hillary Rodman[4]; [1]Emory University

Blue light can impact mood, emotion, and cognition through retinal projections, including from intrinsically photosensitive retinal ganglion cells (ipRGCs), to neurological structures such as the suprachiasmatic nucleus, limbic regions including the amygdala, and the lateral habenula, among others. Solar illumination has been consistent throughout human existence. However, modern cities expose us to blue-enriched lighting environments that do not necessarily mimic sun light. ipRGCs in particular may play an important role as they are especially sensitive to blue light and are involved in many non-image forming processes.

Here, we examined the impact of blue light on the interpretation of facial expressions in the late morning and early evening. One-hundred and fifty undergraduate students (44 male, 106 female) completed a facial expression processing task under either brighter (131.4 lux) blue-enriched, broad-spectrum illumination (ipRGC driving), or dimmer (13.76 lux), warm illumination with little blue light (ipRGC neutral). Participants viewed happy, sad, angry, fearful, and neutral expressions from two models (one male, one female) for 100 ms and 1,500 ms at 40%, 75%, and 100% expressiveness, and then identified each emotion in a forced choice format. There were no mean differences between the lighting-condition groups for accuracy of expression identification, either overall or for individual expressions. However, by examining the pattern of errors, we determined that, in blue compared to warmer light, when participants were wrong on any given trial, they tended to be wrong towards negative expressions, and away from positive or neutral expressions. Additionally, there was a similar trend for neutral target expressions, such that participants tended to misidentify neutral targets as negative rather than happy expressions in blue light. These data suggest that, when exposed to blue-enriched light, people are subtly biased towards mistaking any expression for a negative one.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1313

Faces: Familiarity

Automatic detection of changes of configural processing of own-race and other-race faces: A visual MMN study

Poster Presentation - *Topic area: Faces: Familiarity*

wei wang[1] (510431676@qq.com), DanMin Miao[2], Lun Zhao[3], WeiSheng Xu[1]; [1]Department of criminal psychology, Northwest University of Political Science and Law, [2]Department of psychology, Air Force Medical University, [3]School of Psychological Research, Beijing Yiran Sunny Technology

Faces are socially very important visual objects and the detection of a change in faces is an essential evolutionary skill. It has been shown that recognizing faces in adults is attributed to configural computation. Although recent studies have shown that own-race faces are better remembered and are

code more configural when compared with memory for faces of other-race faces. However, it is not yet understood whether the facial configural processing own-race bias could occur under a non-attentional condition. Therefore, we investigated to collect evidence on the configured processing of own-race faces and other-race faces under non-attentional condition by recoding and analyzing the mismatch negativity (MMN) of event-related potentials (ERPs) in the normally configured faces and distorted faces. As a first step, we recorded the vMMN elicited by configural and component coding of own-race faces and other-race male faces in Chinese participants respectively. We manipulated their spatial relations (the second-order relation configural computation) own-race faces and other-race faces, using a novel morphing method to vary difficulty parametrically. The results showed that the N170 was sensitive neither to configural distortions nor to faces' races. Besides, compare with original faces, faces with configural information changes elicited larger P200 amplitudes by Caucasian faces. It is worth noticing that own-race faces elicited larger vMMN amplitudes than other-race faces. These findings confirm that the configural computation of own-race face and other-race faces can be independent on attention. These data provided electrophysiological evidence for automatic detection of configural changes of own-race face and other-race faces under unattended conditions.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1000

Getting to know you: altered response in occipital-temporal cortex after personal familiarization

Poster Presentation - *Topic area: Faces: Familiarity*

Charlotta Eick[1] (charlotta.eick@uni-jena.de), Géza Gergely Ambrus[1], Gyula Kovács[1]; [1]Friedrich-Schiller University Jena

The process when we get to know a person makes his/her initially unfamiliar face familiar and alters its cortical representation. Recently, it has been shown that familiar and unfamiliar faces elicit differential steady-state visual evoked potentials (ssVEP) over the occipital-temporal region (OT). Here, we used a personal familiarisation paradigm, to evaluate how originally unfamiliar faces become familiar. Participants (n = 22) were personally familiarized with two female target identities in the course of three consecutive days (minimum 30 minutes of real-life contact over playing a card-game and discussions in a natural environment each day). We recorded the EEG to measure the ssVEPs in a Fast Periodic Visual Stimulation

paradigm for the faces of the target persons and two unfamiliar foil identities (presented with a rate of 0.85 Hz) among unfamiliar female faces (presentation rate - 6 Hz) before and after this familiarization phase. The ssVEP showed an enhanced amplitude to the familiarized faces, when compared to the unfamiliar ones after familiarization over OT regions. Our results indicate that a brief personal familiarization phase is sufficient to alter facial representations and that the ssVEP is sensitive enough to detect these changes.

Acknowledgements: This study was supported by a Deutsche Forschungsgemeinschaft Grant [grant number KO 3918/5-1].

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Dear fellow scientists,
I am happy to have this scientific exchange thanks to the V-VSS despite these crazy times.
If you are interested further in this project/ my work or want a guide through my poster and a discussion about it, feel free to contact me at charlotta.eick@uni-jena.de.
A zoom or skype call is easily set up, I am looking forward to the fruitful conversations.
All the best,
Charlotta
____
M.Sc., PhD Student
http://www.cogsci.uni-jena.de/
Biological Psychology and Cognitive Neuroscience (BPCN)
Friedrich-Schiller-University, Jena, Germany

Abstract ID: 103

Horizontal tuning for same-race and other-race faces

Poster Presentation - *Topic area: Faces: Familiarity*

Isabelle Charbonneau[1] (isabellecharbonneau8@gmail.com), Kim Calvé[1], Justin Duncan[1,2], Caroline Blais[1], Daniel Fiset[1]; [1]Universite du Quebec en Outaouais, [2]Universite de Fribourg

Numerous studies support the critical role of horizontal spatial information in upright face identification. Recently, it was shown that the best face recognizers are more selectively tuned to horizontal information (Duncan et al., 2019; Pachai, Sekuler & Bennett, 2013), and the well-known face inversion effect induces a clear reduction in horizontal tuning for upright faces (Goffaux & Dakin, 2010). In the present study, we compared spatial orientation tuning for same-race and other-race faces in 10 White-Canadian participants.

Participants completed a 5-AFC task in which they had to memorize a target face that appeared for 1000 ms. Participants completed 1,500 trials per race, and both races appeared in different counterbalanced blocks. A learning phase was completed prior to the experiment to assure that participants were able to identify both White-European (SR) and East-Asian (OR) faces with approximately the same accuracy. Selectivity to horizontal facial information was measured with the orientation bubbles method (Duncan et al., 2017), which randomly samples stimulus spatial orientation content on a trial basis. Classification vectors were produced separately for each race by calculating a weighted sum of orientation samples, using standardized accuracies as weights. Overall, successful recognition of both races was associated with horizontal orientation information. However, this link was stronger for SR faces, compared to OR faces (Zcrit = 2.101, $p<0.05$). These results reinforce the crucial role of horizontal facial contour in face recognition with same-race faces and also raise the possibility that these low-level visual information could account for the advantage of same-race faces to be better remembered than other-race faces (i.e. other-race effect; Meissner & Brigham, 2001).

Acknowledgements: CRSNG & CRSH

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 17

Regression to the mean enhances perceptual resolutions of face identification

Poster Presentation - *Topic area: Faces: Familiarity*

Tal Lulav-Bash[1,3], Galia Avidan[3], Nahal Binur[1], Bat-Sheva Hadad[1,2]; [1]Cognitive Developmental Lab, University of Haifa, Haifa, Israel, [2]Edmond J. Safra Brain Research Center, University of Haifa, Haifa, Israel, [3]Ben-Gurion University of the Negev, Beer Sheva, Israel

Perceptual resolutions can be improved by contextual influences. This is exemplified in the tendency to be biased towards the center of stimulus sample (regression-to-the-mean (RTM)), thus optimizing outcomes by accounting for noise. We examined whether contextual influences may underlie refined face representations shaped by experience, and the reduced perceptual resolution exhibited in less frequently encountered faces as evident in the “other-race effect”. Participants performed a same/different task on two consecutive faces drawn from a sample of 100 morph levels created from two faces. Order of

presentation was manipulated in different trials: in half of the trials the first face was closer to the mean of the morph continuum (bias+), and in the other half, the first face was further away from the mean (bias-). We surmised that RTM would be manifested in better performance in the bias+ trials, where perceived distance between the two faces increases because of regression of the first face towards the mean. Experiment 1 revealed that for own-race faces, all participants exhibited RTM evident during the first or second session. The extent of the RTM effect correlated with performance on face perception tests, indicating its relevance to face processing. Experiment 2 revealed that for other-race faces, RTM was evident in all participants already during the first session. However, the other-race effect was demonstrated for the bias- trials, but was diminished for the bias+ trials, implying that the poor face representations of other-race faces may originate from a weak reference. When a strong reference facilitated discrimination (bias+ trials), the disadvantage of other-race faces was no longer evident. The results suggest that better resolution of face representation can be achieved when a strong reference of a typical, averaged face is established. Moreover, mechanisms of perceptual inference enhancing general perceptual resolutions may underlie the way experience refines face representations.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1177

Faces: Gaze and fixation

Configural face differences are perceivable extrafoveally

Poster Presentation - *Topic area: Faces: Gaze and fixation*

Elizabeth A. Kruse[1], Kunjan D. Rana[1], Leslie G. Ungerleider[1]; [1]Laboratory of Brain and Cognition, National Institute of Mental Health, Bethesda, MD

A critical component of face detection is the processing of the configural aspects of the face, namely, the spatial positioning of facial components with respect to each other. This is in contrast with the featural aspects of a face, namely, the local properties, such as eye shape, nose shape, etc. Perceptually, low spatial frequencies play a large role in configural processing, whereas high spatial frequencies play a large role in featural processing (Goffaux et al, 2005). In this study, our goal was to determine whether the type of face difference, configural or featural, affects facial discrimination extrafoveally. Subjects were presented a face at fixation for 1500 ms, then, after a 200 ms high-contrast noise mask, were presented a second face at a

location of varying eccentricity to the left or right of the original face for another 1500 ms. Subjects were cued to the location of the second face from the start of the trial until the presentation of the second face with a high-contrast noise pattern indicating where the face would be located. In 50% of the trials, the two faces were the same, and in the other 50%, the faces differed by a configural difference (spacing between eyes or distance from nose to mouth) or a featural difference (eye shape or nose shape). Subjects were asked to respond via button press if the second face differed from the first face without moving their eyes from a centrally presented fixation cross. We found above chance detection of configural face differences in the parafovea, whereas we did not find significant detection of featural differences outside of central vision. Our results show that configural face differences can be used to discriminate faces extrafoveally.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 770

Foveal selectivity in holistic processing of Mooney faces

Poster Presentation - *Topic area: Faces: Gaze and fixation*

Teresa Canas-Bajo[1] (tere93@gmail.com), David Whitney[1]; [1]University of California, Berkeley

Humans are remarkably sensitive to peripheral faces, which indicates that face recognition processes operate across the visual field. However, it remains unclear whether face recognition sensitivity varies across eccentricity depending on the degree to which holistic templates are required. To investigate foveal and peripheral sensitivity in holistic processing, we tested subjects on a gender discrimination task using 90 Mooney faces (stimuli extracted from Schwiedrzik, Melloni, & Schurger, 2018), which are readily perceived as faces despite lacking low-level segmentable face-specific features. In an independent experiment, the Mooney faces were divided into two operational groups depending on the extent to which they require holistic processing: those faces that tap relatively more into holistic processing and those faces that tap relatively less into holistic processing. We then compared performance in the fovea and at different eccentricities across the peripheral visual field. Faces that relied less on holistic processing were recognized easier and more or less unimpaired up to an eccentricity of twelve degrees. On the other hand, highly holistic novel faces were uniquely more difficult to recognize in the periphery. This suggests that there are more concentrated holistic templates in the foveal region. Weaker holistic peripheral processing and a slight asymmetry favoring holistic processing in the left visual field (right hemisphere) replicates prior work (Ramon, Meike, Rossion, 2012). In addition to this, we found that adding face flankers interfered with holistic face recognition and delayed it, replicating and extending prior work (Farzin, Rivera & Whitney,

2009). Taken together, our results show a foveal selectivity of holistic processing. Future work should investigate whether training individual face identities may mitigate the holistic disadvantage found in the periphery.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York
24 June, 1:00 am EDT America/New_York

Presenter's Message

Please feel free to contact me for any questions or comments at teresa_canasbajo at berkeley.edu. Looking forward to hear your thoughts and ideas!

Abstract ID: 432

Gaze perception and the integration of head and pupil rotations on 2D and 3D robotic models: Typical development and the impact of Autism Spectrum Disorder

Poster Presentation - *Topic area: Faces: Gaze and fixation*

Diana Mihalache[1] (diana.mihalache@du.edu), Peter Sokol-Hessner[1], Huanghao Feng[1], Farzaneh Askari[2], Eric J. Moody[3], Nuri Reyes[4], Mohammad H. Mahoor[1], Timothy D. Sweeny[1]; [1]University of Denver, [2]McGill University, [3]Wyoming Institute for Disabilities, University of Wyoming, [4]JFK Partners, University of Colorado Anschutz Medical Campus

Gaze perception is an integrative visual process in which another person's direction of attention is inferred by the rotation of their pupils and head. Yet the empirical study of gaze has largely focused on a single cue—the eyes. While this literature suggests that gaze perception is shaped by typical and atypical development, as in Autism Spectrum Disorder (ASD), it may not capture how gaze is actually seen, as an emergent feature. Our goal was to understand how the integrative process of gaze perception unfolds in and is accounted for by typical and atypical development across individuals. We thus examined emergent gaze among children and adolescents (ages 7-17) who are typically-developing (N=26; Age M= 10.5; SD= 2.21) or with ASD (N = 25; Age M = 10.7; SD = 2.58). Observers viewed faces with multiple combinations of head and pupil rotations and indicated whether gaze was directed leftward or rightward, both on 2D faces and a physically-present, 3D robot. We thus quantified emergent gaze across a range of stimulus complexities and sidestepped the anxiety of human interaction, effectively capturing both 2D- and 3D-gaze perception in our ASD sample. Using multiple logistic regression, we measured the extent to which each

observer relied on the head and eyes. Building on our previous work, we found that both typically-developing and ASD groups utilized head and pupil rotations to judge 2D gaze. Relative to 2D judgments, pupil use increased for 3D faces whereas head use was more inconsistent across individuals. Reliance on both of these cues was reduced among observers with ASD. Additionally, pupil use increased with age independent of ASD diagnosis. This work demonstrates that emergent gaze perception is a slowly developing process that is surprisingly intact, albeit weakened in ASD, and also illustrates how new technology can bridge visual and clinical science.

Acknowledgements: This study was supported by Grant R15HD090581 from the National Institute of Child Health and Human Development at the National Institutes of Health.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1245

Variations in the perception of facial gender across the visual field

Poster Presentation - *Topic area: Faces: Gaze and fixation*

Annie Morsi[1] (annie.morsi.18@ucl.ac.uk), Valerie Goffaux[2,3,4], John, A. Greenwood[1]; [1]University College London, [2]Research Institute for Psychological Sciences, Université Catholique de Louvain, Belgium, [3]Institute of Neuroscience, Université Catholique de Louvain, Belgium, [4]Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, The Netherlands

Visual ability is not equal across the visual field but instead varies in characteristic ways. For example, tasks that measure low-level vision, such as letter acuity or orientation judgements, reveal superior vision in the lower compared to the upper half of the visual field (upper-lower anisotropy). Recent research suggests that face perception may not show the same pattern of anisotropies, with variations that are instead specific to each individual. This study aimed to bridge the gap between these variations in low and high-level vision by measuring acuity for judging facial gender in different regions of the visual field. Participants reported the gender of upright or inverted faces that appeared at 8 locations in the periphery (at 10° eccentricity). Face size was varied on each trial according to a QUEST procedure, with acuity thresholds calculated as the smallest size necessary to judge gender at each location. Results show that for both upright and inverted faces, performance was better in the lower compared to the upper half of the visual field, and along the horizontal (East and West combined) compared to the vertical (North and South combined) axis. These variations in gender acuity align with those found for simpler tasks (e.g. orientation

discrimination), providing a direct link between low and high-level vision. Inversion effects were found at all locations and were greater along the horizontal compared to the vertical meridian. These common anisotropies challenge the current literature by showing that recognition of facial gender differs across the visual field in ways analogous to low-level vision. This ties in with a hierarchical model of face recognition, whereby face-selective brain regions inherit the spatial properties of earlier visual areas (e.g. the same resolution patterns) when building complex face representations.

Acknowledgements: Supported by the Biotechnology and Biological Sciences Research Council [BB/M009513/1].

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 791

Faces: Individual differences

A comparison of regimens for training face matching

Poster Presentation - *Topic area: Faces: Individual differences*

Necdet Gurkan[1] (ngurkan@stevens.edu), Jordan W Suchow[1]; [1]Stevens Institute of Technology

Human performance in matching unfamiliar faces to images is known to be poor, with far-reaching implications in a variety of workplace settings. Luckily, expertise for recognizing and matching particular individuals is highly trainable — through exposure, we can learn to distinguish even identical twins. Popular training methods ask participants to repeatedly perform a matching task or recognition task using photographs of the target identities, with feedback given after each trial. However, by limiting the training set to only original photographs of the target individuals, many of these training tasks are too easy and result in inefficient perceptual learning, with performance quickly hitting the ceiling. Here, we compare the effectiveness of more challenging face-training regimens that focus on the differences among a set of target faces to be learned. To accomplish this, we make use of recent advances in machine learning that provide the capability to encode photographs into a learned face space and then generate photorealistic morphs that interpolate between mid-level features of the depicted individuals, such as the taper of the chin and bushiness of the eyebrows. In particular, we used the StyleGAN neural-network architecture to generate several challenging variants of the Glasgow Face Matching Test (GFMT). In each variant, we morph each face towards the centroid of the set of all GFMT faces in the learned face space. We then empirically compare the efficacy of these GFMT variants for training face matching, measuring transfer of learning from the trained set to the original faces.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1690

Building calibrated face-identification ability test with Item Response Theory

Poster Presentation - *Topic area: Faces: Individual differences*

Géraldine Jeckeln[1] (gxj150130@utdallas.edu), Ying Hu[1], Jacqueline G. Cavazos[1], Amy N. Yates[2], Carina A. Hahn[2], Larry Tang[3], Alice J. O'Toole[1], P. Jonathon Phillips[2]; [1]University of Texas at Dallas, [2]National Institute of Standards and Technology, [3]University of Central Florida

Accurate estimates of face-identification ability are crucial in applied forensic settings. Current face-identification datasets are often large and uncalibrated, making them sub-optimal for pre- and post-training evaluations. To optimize efficient and accurate performance assessments, small sets of well-labelled test items are needed. However, item-wise measures cannot be applied to the common forensic task of identity matching in image pairs, because items are either "matched" or "non-matched" identities. Therefore, in this case, an item response confounds item accuracy and response bias. Here, our goal was to construct flexible, well-calibrated subsets of face-identification items using Item Response Theory (IRT) applied to image triads. These triads were composed of two images of one identity and one image of a different identity; the task was to select the "different" identity. Participants (n=77) were tested on the full item pool of 224 face-image triads. Responses were analyzed using the IRT one-parameter model (Rasch model; Rasch, 1960). This approach provides measurements of subject ability and item difficulty on the same scale. Results of the model demonstrate the probability of endorsing a correct response given an item's difficulty and a subject's ability. Using these results, we constructed subsets of items that varied in item difficulty. To test the quality of these item subsets, we used responses to these subsets to estimate participants' ability and predict accuracy for larger subsets of novel items. Leave-one-out cross validation results showed that we can predict both people's accuracy on novel items and their individual responses.

These calibrated face-identification tests can be used to develop face-identification tests with better flexibility, reliability, and time-efficiency.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 579

Human face matching performance is predicted by deviation from algorithmic similarity

Poster Presentation - *Topic area: Faces: Individual differences*

Mirta Stantic[1] (mirta.stantic@psy.ox.ac.uk), Caroline Catmur[2], Bradley Duchaine[3], Geoffrey Bird[1,2];
[1]University of Oxford, [2]Kings College London, [3]Dartmouth College

Human face perception, one of our seemingly most automatic cognitive abilities, has long been of interest to computer vision scientists. Most of the comparisons of humans and computer vision algorithms to date focused on accuracy, but few examined mechanisms underlying this ability. The current study explores the relationship between human judgments of face similarity and algorithmic estimates of perceptual similarity. Participants ($N = 141$, Mage = 27.2, 73 female) completed a face similarity judgment task (presentation randomized between same and different pairs) as well as a battery of standard face perception tasks. They were asked to rate the similarity of pairs of faces between 0 (very dissimilar) and 100 (very similar) and indicate whether the pair was of the same person or different people. A medium-sized correlation between similarity judgments given by humans and algorithms was observed ($r = 0.44$, $p < 0.01$). More interestingly, participant's deviation from algorithmic similarity was a significant predictor of their performance on a variety of other traditional face-recognition measures ($F(2, 138) = 2.682$, $p < 0.05$, $R2 = 0.063$). Furthermore, this relationship was only significantly predicted by deviation of similarity judgments from algorithmically-derived similarity ($r = -0.22$, $p < 0.05$) and not by overall variability of individual's responses ($r = -0.12$, $p = 0.20$) or their response times ($r = 0.05$, $p = 0.59$). This finding suggests that the ability to objectively assess the similarity of two faces might be a crucial underpinning in face recognition mechanisms captured by a variety of established face tests. Furthermore, similarities derived from deep-neural-net algorithms seemingly capture an important aspect of face similarity that humans rely on in a variety of tasks. We discuss potential implications for future research directions, particularly in explaining atypical mechanisms of high-level perception in autism or developmental prosopagnosia.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

Happy to chat at another time - please email me at mirta.stantic@psy.ox.ac.uk to arrange!

Abstract ID: 508

Individual and population differences in face categories

Poster Presentation - *Topic area: Faces: Individual differences*

Kassandra R. Lee[1] (kassandral@nevada.unr.edu), Koyo Nakamura[2], Yusuke Nakashima[3], Masami Y. Yamaguchi[3], Katsumi Watanabe[2], Michael A. Webster[1]; [1]University of Nevada, Reno, [2]Waseda University, Tokyo, Japan, [3]Chuo University, Tokyo, Japan

Individuals can be exposed to very different diets of faces depending on where they live and their social environment, and these stimulus differences are thought to shape their perception of faces through processes including adaptation and learning. We explored variability in face percepts by comparing face categorization judgments for the same face images for adults in Tokyo, Japan or Reno, Nevada. Stimuli were morphs between 4 pairs of averaged faces differing in gender (female vs. male) or nationality (Japanese or Swiss). Observers classified different levels of the morphs according to the 4 different categories, with the category boundary and sensitivity estimated from probit fits to the psychometric functions. For both the gender and ethnicity judgments, the overall mean boundaries and sensitivity were similar across the two locations and regardless of the respondents' gender. In contrast, individual differences within each group were very large, and substantially greater than the within-subject variability (estimated from repeated measurements). These individual differences also showed moderate correlations across some of the pairs (e.g. covarying ethnicity boundaries for male or female pairs). Similarities across the groups could not be accounted for by within-session adaptation or range effects for the face arrays, because for two pairs the categories were strongly skewed toward one of the original faces in the morph. For the conditions of these studies, the results instead suggest that cross-cultural factors may exert relatively limited influence compared to factors that determine an individual's face categories, a pattern reminiscent of individual and population differences in color categories.

Acknowledgements: Supported by EY-010834, Grant-in-Aid for Scientific Research on Innovative Areas (17H06344), Strategic Japanese-Swiss Science and Technology Programme from JSPS

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please contact me at kassandral@nevada.unr.edu. I'd be happy to answer any questions. Happy VSS!

Abstract ID: 1633

Multivariate pattern analysis reveals domain-general enhancement of visual representations in individuals with "super-recognition" of faces

Poster Presentation - *Topic area: Faces: Individual differences*

Simon Faghel-Soubeyrand[1,2] (simonsoubeyrand@gmail.com), Meike Ramon[4], Eva Bamps[5], Matteo Zoia[4], Jessica Woodhams[2], Arjen Alink[3], Frédéric Gosselin[1], Ian Charest[2]; [1]University of Montreal, [2]University of Birmingham, [3]University Medical Center Hamburg-Eppendorf, [4]University of Fribourg, [5]KU Leuven

Individual differences in human vision are ubiquitous, but poorly understood. Here, we aimed to understand the neural dynamics and representational code underlying outstanding visual processing abilities. We recruited 15 "super-recognizers" (SRs; individuals in the top 2% of face-recognition ability spectrum) and their matched-controls. Participants completed two visual tasks totalling >80,000 trials per group while we measured their brain activity with high-density EEG. We performed multivariate analyses on the time-resolved brain patterns of both groups while they identified newly learned faces. Specifically, we produced the time-course of task-related representational distances between face identities. This analysis revealed more distinct identity representations in SRs after the first feedforward sweep of the visual system (200-500ms after face-onset), accompanied by stronger face-identification performance of experimentally learned identities. These results indicate that the real-life diagnostic advantage for faces in SRs is associated with richer brain representations for face stimuli. Next, we ask whether this superior visual processing extends beyond faces, i.e. whether it is domain-general. We assessed this in a second EEG experiment during which Representational Similarity Analysis was used to characterise the representational code behind their processing of a wide set of visual stimuli (including objects, animals, scenes). This showed increased distinction between face vs non-face category representations in SRs, but also revealed more distinct representations within non-face categories, indicating an enhancement that extends beyond face stimuli. Considering the time-course of all these findings (>200ms), we propose that super-recognition is underlied by visual representations that are enriched by a recurrent, domain-general mechanism. This study provides the first evidence for a direct link between real-life visual abilities and the richness of stimulus representations in the human brain. In addition, our findings suggest that the general quality of a person's representations, even of simple objects, predicts their ability to recognize faces of different individuals around them.

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Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Mail me (simonsoubeyrand@gmail.com) for any question, comment or to set up a zoom!!

Abstract ID: 502

Observer-dependency of the brightness perception of facial skin influenced by skin colors

Poster Presentation - *Topic area: Faces: Individual differences*

Yuanyuan He[1], Taiga Mikami[1], Suguru Tanaka[1], Yoko Mizokami[1]; [1]Chiba University, Japan

Human skin color is one of the most common colors which we see in everyday life. The skin color distribution of young Japanese women showed a trend that yellowish skin had higher lightness than reddish skin. Whereas, it was shown that reddish skin appeared brighter than yellowish skin when both had the same lightness (Yoshikawa et al., 2012). However, it is not clear how the brightness perception of facial skin is influenced by the diversity of skin colors and observers. Here, we investigate the brightness perception of facial skin for observers in different genders and countries. A young Japanese female face as an original face was used. In this study, we prepared test faces with four skin color types that were the average skin colors of Japanese, Thai, Caucasian, and African. A test image (with constant lightness and different hue angle) and a scale image (with the original hue of each skin color type varying lightness) were presented side by side on a color-calibrated tablet display and observers adjusted the brightness of facial skin of the scale image to match that of the test image. As a result, Japanese observers showed a trend that reddish skin appeared brighter than yellowish skin which was consistent with the previous study, but Thai and Chinese observers did not. We did not find a clear difference between male and female observers. Our results imply that there is the influence of ethnicities or environments on the brightness perception of facial skin.

Acknowledgements: JSPS KAKENHI JP 16H01663 & 18H04183

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1703

Reflection Rumination Reduces Negative Emotional Processing During Goal-Directed Behavior.

Poster Presentation - *Topic area: Faces: Individual differences*

Jessica Renaud[1] (renaudj@mail.usf.edu), Max Owens[1]; [1]University of South Florida

Depression is a severe disorder of brain function, however the links between risk factors contributing to the severity of its episodes is unclear. To help fill this gap in the literature this study looked at the relationship between negative biases and rumination. Negative biases are common in depression and are thought to arise from inefficient functioning between cognitive control and emotion processing brain regions. Rumination is a repetitive and narrowed attentional focus on the causes and symptoms of depression. Rumination is comprised of at least two sub-components, reflection, which is a goal-directed form, and brooding, a more passive form. The link between rumination and negative biases was examined on an emotional delayed match to sample working memory task. In the task participants were asked remember a set of neutral faces across a delay period, where novel sad, happy or scrambled face distractors are presented. Participant memory accuracy was collected, and using EEG the amplitudes of the late positive potential (LPP), an event-related component of emotion processing, were recorded in response to distractors. In line with expectations LPP amplitudes increased for emotional versus scrambled face distractors. Depression and rumination did not significantly impact accuracy, however, a significant emotion by reflection interaction on LPP amplitudes was observed. Specifically, as reflection scores increased, LPP amplitudes for sad faces decreased relative to amplitudes for scrambled faces. Together, results show reflection is associated with a goal directed decrease of negative emotional processing to maintain task performance, and may indicate one path for influencing cognitive inefficiency in depression. Results are discussed in relation to cognitive models of depression.

Acknowledgements: Current study is funded by University of South Florida New Researcher Award, and no conflicts of interests are reported.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1206

The relation between Horizontal Tuning for Faces and Face Processing Abilities

Poster Presentation - *Topic area: Faces: Individual differences*

Gabrielle Dugas[1], Justin Duncan[1,2], Jessica Royer[3], Isabelle Charbonneau[1], Caroline Blais[1], Daniel Fiset[1]; [1]Universite du Quebec en Outaouais, [2]Universite de Fribourg, [3]Universite McGill

Recent studies have highlighted the important role of horizontal spatial information for many aspects of face processing, such as face detection (Balas, Schmidt & Saville, 2015), face identification (Goffaux & Dakin, 2010), and facial expression recognition (Huynh & Balas, 2014). One study has also reported an association between horizontal tuning for faces and face recognition ability (Pachai, Sekuler, & Bennett, 2013). However, these measures were obtained within the same task, which could have led to an overestimation of the true correlation. Therefore, in this study, horizontal tuning for faces and face processing ability of 37 subjects were measured with independent tasks. A face ability score was extracted based on performance in tree well known face processing measures (Cambridge Face Perception Test, Cambridge Face Memory Test +, and Glasgow Face Matching Task), using principal component analysis. Subjects also completed a task (600 trials) in which they were asked to identify face stimuli randomly filtered with orientation bubbles (Duncan et al., 2017). This method allowed us to extract individual orientation profiles for faces, and in turn, horizontal tuning scores. Orientation profiles were extracted on a subject basis by computing a weighted sum of orientation filters across trials, using standardized accuracies as weights. Horizontal tuning was then calculated as the weighted sum of orientation profile vectors dot-multiplied with a Von Mises distribution (FWHM = 42 deg) centered on the -90 deg horizontal axis. We then measured the association between horizontal tuning for faces and face processing ability scores, and observed a significant positive correlation, $r= 0.4$, CI 95%= [0.13; 0.64], $p<0.05$. Importantly, this relation could not be explained by factors such as horizontal tuning for cars, object-processing ability, or low-level sensitivity to horizontal gratings. Our results further reinforce the hypothesis according to which horizontal spatial structure is crucial for face processing.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 834

Faces: Neural mechanisms

Anatomical folding predicts the location of face-selective domains in macaque IT

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Michael Arcaro[1], Theoroda Mautz[2], Margaret Livingstone[2]; [1]University of Pennsylvania, [2]Harvard Medical School

Previous studies have revealed correspondences between cortical topology and brain function for primary (Hinds et al. 2008; Rajimehr & Tootell 2009) and extrastriate visual cortex (Weiner et al. 2014; Witthoft et al. 2014). Here, we looked at the relationship between cortical folding and regions within macaque inferotemporal cortex (IT) that are selectively active when viewing faces. These regions are located in stereotypical locations across individuals, though correspondence with particular anatomical features has not been previously reported. We performed functional and anatomical neuroimaging on thirteen macaques. Seven monkeys were raised in environments where they did not see faces and did not develop face-selective domains. Six control monkeys were raised with normal visual experience of faces and developed face-selective domains. Face-selectivity was probed in a localizer scan session. To measure cortical topology, surface models were reconstructed for each monkey from anatomical volumes. We reveal a structure-function relationship between cortical folding in the superior temporal sulcus (STS) and the location of the middle face(-selective) patch (ML). Within the STS, we identified several “bumps” (convexities) in consistent locations across individuals. In control monkeys, ML was localized to one particular bump within central IT, demonstrating that topological features of the STS can serve as landmarks for functional specialization. This bump was present at birth and existed in monkeys that lacked face-selective domains. These results demonstrate that cortical folding may predict the location of functional specializations in IT but are not sufficient for their development. These “bumps” may not be directly related to face-selectivity, but rather, likely emerge in utero along with early architecture such as retinotopic maps, which also predict where face domains develop (Arcaro et al. 2017). Such a relationship between cortical folding and retinotopy may emerge from general mechanisms such as mechanical pressures that preserve connections across retinotopically matched regions (Van Essen 1997).

Acknowledgements: RO1 EY 16187, P30 EY 12196

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 440

Cross-species characterization of facial expression and head orientation processing

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Hannah Wild[1], Shivani Goyal[1], Shruti Japee[1], Leslie Ungerleider[1], Jessica Taubert[1]; [1]Laboratory of Brain and Cognition, NIMH, NIH

Faces convey substantial information, some of which is stable – like identity and gender, and some transient – like expression and head orientation. Face-selective regions in the brain may respond differently to these distinct types of information. To test this, we used a fMRI-adaptation paradigm in rhesus macaques to determine the role of face-selective patches in the processing of facial expressions and head orientation of a monkey avatar. Three subjects (Macaca mulatta) were scanned in a 4.7T Bruker scanner while fixating on blocks of images that varied either in: (1) the expression and head orientation of the avatar; (2) the expression but not head orientation; (3) the head orientation but not expression; or (4) both were held constant. The results showed that face patches in the fundus (AF and MF) of the superior temporal sulcus (STS), as well as in the amygdala, were more sensitive to changes in expression than to changes in head orientation, whereas the anterior lateral (AL) face patch responded more to changes in the avatar's head orientation and less to expression. This dissociation reinforces existing theories claiming that the fundus of the STS is involved in processing expression, while also providing a new framework for understanding how the visual system simultaneously extracts independent, transient signals from a face. Similar ongoing studies in humans will examine if a parallel dissociation exists in that species, such that STS and ventral temporal cortex are more sensitive to changes in facial expression and head orientation, respectively.

Acknowledgements: NIMH Intramural Research Program

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1273

Dissociated face- and word-selective intracerebral responses in the human ventral occipito-temporal cortex

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Simen Hagen[1], Aliette Lochy[2], Corentin Jacques[3], Louis Maillard[1,4], Sophie Colnat-Coulbois[1,5], Jacques Jonas[1,4], Bruno Rossion[1,3,4]; [1]Universite de Lorraine, CNRS, CRAN, F-54000 Nancy, France, [2]Cognitive Science and Assessment Institute, University of Luxembourg, [3]Psychological Sciences Research Institute and Institute of Neuroscience, University of Louvain, B-1348 Louvain-La-Neuve, Belgium, [4]Universite de Lorraine, CHRU-Nancy, Service de Neurologie, F-54000 Nancy, France, [5]Universite de Lorraine, CHRU-Nancy, Service de Neurochirurgie, F-54000 Nancy, France

The extent to which faces and written words share neural circuitry in the human brain is actively debated. We provide an original contribution to this debate by comparing face-selective and word-selective responses in a large group of patients (N=37) implanted with intracerebral electrodes in the ventral occipito-temporal cortex (VOTC). Both face-selective (i.e., significantly different responses to faces vs. nonface objects) and word-selective (i.e., significantly different responses to words vs. pseudofonts) neural activity is isolated through frequency-tagging (Jonas et al., 2016; Lochy et al., 2018, respectively). Critically, this approach allows disentangling category-selective neural responses from general visual responses. Overall, we find that 69.26% of significant contacts show either face- or word-selectivity, with the expected right and left hemispheric dominance, respectively (Fig.1A,B). Moreover, the center of mass for word-contacts is more lateral than for face-contacts, with no differences in postero-anterior axis (Fig.2A). Spatial dissociations are also found within core regions of face and word processing, with a medio-lateral dissociation in the fusiform gyrus (FG) and surrounding sulci (FG+sulci;Fig.2B), while a postero-anterior dissociation is found in the inferior occipital gyrus (IOG;Fig.2C). Despite their spatial dissociations in the FG+sulci and IOG, most overlap in category-selective responses is found in these regions (Fig.1C). Critically, in the overlap-contacts, across the whole brain or specifically in the FG+sulci, between-category (word-face) selective-amplitudes showed no-to-weak correlations, despite strong correlations for within-category (face-face, word-word) selective-amplitudes (Fig.3A), and a strong correlation in non-selective general-amplitudes to words-faces. Moreover, substantial overlap and no-to-weak correlations were observed between faces and a control category (houses) known to be functionally dissociated from faces. Overall, we conclude that category-selectivity for faces and words is largely dissociated in the human VOTC, with a limited spatial overlap likely due to the distant recording of dissociated populations of neurons rather than to shared category-selective representations.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 713

Dynamic domain specificity in ventral temporal cortex during visual object perception

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Brett Bankson[1,2,4] (brett.bbankson@gmail.com), Matthew Boring[1,3,4], R. Mark Richardson[5,6], Avniel Singh Ghuman[1,2,3,4]; [1]Laboratory of Cognitive Neurodynamics, University of Pittsburgh, [2]Cognitive Program, Department of Psychology, University of Pittsburgh, [3]Center for Neuroscience at the University of Pittsburgh, University of Pittsburgh, [4]Center for the Neural Basis of Cognition, [5]Department of Neurosurgery, Massachusetts General Hospital, [6]Harvard Medical School

An enduring debate regarding the functional architecture of the cortex is whether different kinds of information are represented by distributed and overlapping neural circuits or are restricted to networks specialized for particular domains of information. Neural recordings, lesions, and stimulation show that the perception of particular visual categories is causally related to the activity in category-selective patches of ventral temporal cortex. On the other hand, visual deficits caused by lesions are rarely, if ever, “pure,” and information about categories can be found outside of patches selective for those categories. Given that category-level discrimination is generally spared in various agnosias, a critical tension between domain-specific vs. distributed models is whether individual-level discrimination can be found outside of putative category-selective areas. To address this tension, intracranial recordings from 17 epilepsy patients were used to assess the spatiotemporal representation for individual faces and words in human temporal cortex. Recordings from a category localizer task were used to measure category selectivity in all electrodes located in ventral temporal cortex. Multivariate classification was used to analyze the spatiotemporal dynamics of individual face or word discrimination inside and outside these category-selective cortical patches. The results of this analysis show that single faces and words can be individuated both within and outside of category-selective patches, but the respective representations emerge approximately 200 ms earlier inside than outside the selective patches. Further analyses reveal that the information represented outside of category-selective patches is non-redundant with the information within these patches, and thus the non-selective regions contribute to the overall neural representation though in a later stage of processing. These results provide a potential resolution between domain-specific and distributed models of visual perception by suggesting that the cortical representation is dynamic, with processing first primarily restricted to domain-specific networks followed by a distributed processing stage.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 115

Face identity processing at 33 ms and 100 ms with 4 ms of stimulus exposure

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Alison Campbell[1] (alison.candice.campbell@gmail.com), James W. Tanaka[1]; [1]University of Victoria

Measuring the processing time from presentation to identification has proved difficult: Reaction times are slowed by decision-making and motor response processes, and although advances in neural representational analysis provide new insight on the speed of neural response, the relationship between these representations (e.g., decoding accuracy) and behaviour is not well understood. We used a psychophysical approach to measure the threshold for conscious access to face identity at 4 stages of processing: the minimum exposure duration, access to low-level information, access to high-level category information, and access to high-level identity information. In Experiment 1, 4ms of exposure was sufficient for identification and increasing exposure did not improve performance. In subsequent experiments, targets were presented for 4ms and the time available for processing the target was constrained by backward-masking and varying SOA between 8-213ms. In Experiment 2, a diffeomorphic transformation of the target image that preserves basic perceptual properties but obliterates high-level properties was used to effectively mask and limit access to the low-level properties of the target (Stojanoski & Cusack, 2014). With this mask, we found a threshold of only 33ms for above-chance identification. Targets were then masked by unfamiliar faces (Experiment 3) and familiar faces (Experiment 4) to mask the high-level face category and face familiarity properties of the target, respectively. The main findings were that unfamiliar faces were as effective as familiar faces in masking target identity; moreover, the psychometric function observed when masking with a diffeomorphic scramble indicates a narrow window of time needed to process low-level perceptual properties, whereas the functions observed when masking with another face show a gradual accumulation of evidence. The data indicate that as little as 33ms of uninterrupted processing is required to extract the low-level properties and ~100ms to extract the high-level properties needed for conscious access to a familiar face identity.

Acknowledgements: This work was supported by a grant to JT from the Natural Sciences and Engineering Research Council of Canada.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thanks for "stopping by" my poster. For questions or comments, feel free to contact me by chat, zoom, or email at campbel1@uvic.ca

Alison

Abstract ID: 1478

Nonlinear VEP: Facial emotional information is present in early V1 processing

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Eveline Mu[1] (emu@swin.edu.au), David Crewther[1]; [1]Swinburne University of Technology

The magnocellular system has been implicated in the rapid processing of facial emotions, such as fear. Of the various anatomical possibilities, the retino-colliculo-pulvinar route to the amygdala is currently favoured. However, does the focus on amygdala processing of motion imply that emotional information reaches the primary visual cortex (V1) at later times? Non-linear visual evoked potentials provide a well-accepted technique for examining temporal processing in the magnocellular and parvocellular pathways in visual cortex. Here we investigated the relationship between facial emotion processing and temporal analysis of the magnocellular (K2.1) and parvocellular (K2.2) contributions to achromatic non-linear multifocal visual evoked potential responses recorded from occipital scalp (OZ). Stimuli comprised pseudorandom brightening/darkening of fearful, happy, neutral faces (or no face) with surround patches decorrelated from the central face-bearing patch. For the central patch the spatial contrast of the faces was 30% while the temporal contrast of the per-pixel brightening/darkening was 10% or 70% temporal contrast. From 14 neurotypical young adults, we found the standard main effect of contrast for K2.1 amplitude, with decreased amplitudes for 10% temporal contrast stimuli. Importantly, we found a significant interaction between emotion and contrast in the K2.1 peak amplitudes. For the 70% temporal contrast condition, we found smaller K2.1 amplitude for fearful faces, while for the 10% temporal contrast condition, we found smaller K2.1 amplitude for happy faces. Taken together, our findings suggest that facial emotional information is present in early V1 processing. The likely explanation, in terms of the contest between feedback and response gain modulation models, is examined.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 624

The conceptual-social benefit in face recognition is mediated by the social brain network rather than the perceptual face network

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Adva Shoham[1] (advashoham@mail.tau.ac.il), Libi Kliger[1], Galit Yovel[1]; [1]Tel Aviv University

Face recognition benefits from associating conceptual-social information to faces during learning. For example, making trait-inferences, relative to perceptual-evaluations, during face learning improves face recognition. Two hypotheses were proposed to account for this conceptual-social benefit in face recognition. According to the feature elaboration hypothesis, social evaluations encourage elaborated processing of perceptual information for faces. According to a conceptual-social hypothesis, social evaluations convert faces from a perceptual image-based representation to a socially meaningful representation of a person. To test these hypotheses, we ran a functional MRI study in which we functionally localized the occipital-temporal face areas (i.e., perceptual face network) as well as the social brain network (e.g., dmPFC, vmPFC, PCC, TPJ). Prior to scanning, participants watched video clips depicting a social interaction between young adults and were asked to study them for a memory test while making either perceptual evaluations (e.g., how round/symmetric is the face?) or conceptual-social evaluations (e.g., how trustworthy/intelligent does the face look?) about them. During the fMRI scan, participants performed an old/new recognition test on the faces that were presented during the learning phase in the video clips and novel faces. Behavioral findings replicated the conceptual-social benefit in face recognition. Functional MRI results showed higher fMRI signal during recognition for the faces that were evaluated conceptually than perceptually during learning, in the social network areas but not in ventral-occipital face areas. These results support the conceptual-social hypothesis indicating that the conceptual benefit of face recognition is mediated by social rather than perceptual mechanisms.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 656

Time-resolved functional networks involved in discriminating faces with configural differences

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Kunjan D. Rana[1], Amanda C. Del Giacco[1,2], Elizabeth A. Kruse[1], Valentinos Zachariou[1,3], Leslie G. Ungerleider[1]; [1]Laboratory of Brain and Cognition, National Institute of Mental Health, Bethesda, MD, [2]School of Medicine, Oregon Health and Science University, Portland, OR, [3]Department of Neuroscience, College of Medicine, University of Kentucky, Lexington, KY

Human face recognition is a critical cognitive operation that is performed within a fraction of a second. Facial recognition is thought to be mediated by a network of face-selective areas along the ventral visual stream. Zachariou and colleagues implicated the dorsal visual stream in processing configural facial features, namely, the spatial arrangement of face components (Zachariou et al, 2016). Here, we measured the timing and interaction between the dorsal and ventral visual streams during a face discrimination task. Subjects viewed a sequence of faces during a magnetoencephalography (MEG) scan session, organized into 20 blocks of 21 faces. Faces had either configural, featural, or no difference. Subjects pressed a button if the presented face differed from the previous face. Two face-selective regions (occipital face area (OFA) and fusiform face area (FFA)) and one dorsal stream region (intraparietal sulcus (IPS)) were identified using functional localizers. Dynamic Granger Causality (DGC) revealed bidirectional connectivity between OFA and IPS (100-240 ms) and between FFA and IPS (220-310 ms) during configural face differences but not featural differences, whereas DGC revealed a unidirectional connection from OFA to FFA during both configural and featural differences (100-240 ms). Ding and colleagues have proposed that bidirectional Granger connectivity can be caused by a number of interactions, such as being driven by a third source (Ding et al, 2006). We conducted a spotlight search using conditional Granger Causality to locate regions that modulated bidirectional connections. We found a network between 100-240 ms involving early visual cortex (EVC), OFA, and IPS, and a second network between 220-310 ms involving the anterior inferior temporal cortex (aIT), dorsolateral prefrontal cortex (DLPFC), IPS, and FFA. We suggest that the first network processes facial features, whereas the second network performs face discrimination, due to involvement of anterior face areas (FFA and aIT) together with prefrontal cortex.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 743

Voxelwise modeling reveals selectivity for body part identity and location in BOLD fMRI responses to complex naturalistic stimuli

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Matthew Shinkle[1], Mark Lescroart[1]; [1]University of Nevada, Reno

Perception of bodies is central to social interaction, and large portions of human lateral occipitotemporal cortex (LOTC) purportedly represent body parts, poses, and actions. Prior research has found tuning for body parts and their locations throughout LOTC, but the spatial pattern of this tuning has varied. We used voxel-wise modeling to investigate the extent of tuning to both the position and identity of different body parts in BOLD fMRI data. We adapted OpenPose (a deep neural network for pose estimation) to parameterize locations of body parts in three stimulus sets used in previous fMRI studies: static natural images, natural movie clips, and computer-rendered scenes. These large and diverse stimulus sets enabled us to determine how brain responses are specifically related to body part identity and location among other sources of visual variation. We used regularized linear regression to estimate weights relating each voxel to each quantified feature. To validate our model, we correlated its predictions with observed responses in withheld data. Large contrasts between feature weights for well-predicted voxels indicate differential tuning for these features. This model yielded accurate predictions of BOLD responses throughout body- and face-selective areas including LO, FFA, OFA, EBA, and pSTS. Across subjects and stimulus sets, we reliably found a cluster of voxels displaying spatial bias toward the lower, central, contralateral visual field in bilateral caudal EBA. Though natural arrangements of body parts in stimuli can impair discrimination between tuning for different parts, we observed a bias toward hands and arms over faces in the same portion of EBA across all subjects, with inconsistent findings of a few other similarly-tuned regions. With the prior caveat, these results argue against broad selectivity for body parts across all of LOTC, and strengthen previous work suggesting a circumscribed model of body tuning in a few sub-regions near EBA.

Acknowledgements: Pilot grant to ML through NIH COBRE Award P20GM103650

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1675

Why do face- and body-selective areas reside in adjacent locations? A proposed mechanism for decluttering non-human stimuli

Poster Presentation - *Topic area: Faces: Neural mechanisms*

Libi Kliger[1] (libikl@mail.tau.ac.il), Galit Yovel[1]; [1]Tel Aviv University

A well-established feature of primate's high-level visual cortex is the functional organization of face-selective and body-selective areas that reside in adjacent locations. However, the functional significance of this organization is still unknown. It has been recently shown that the representation of multi-category stimuli in category-selective areas is biased towards the preferred category. This bias is formed by a normalization mechanism acting in an area with homogeneous category-selective neurons. This operation enables hard-wired decluttering of non-preferred stimuli that are presented simultaneously with the preferred stimulus. Here we hypothesized that, using the same mechanism, the adjacent location of different category-selective areas may bias the representation to their multiple preferred categories, decluttering other non-preferred stimuli. In particular, the neighboring location of face and body-selective areas would bias the representation of a multi-category scene towards the whole person, while filtering out non-person stimuli. To test this hypothesis, we measured the fMRI response to a scene composed of a person standing next to a chair in a room as well as to the isolated face, body, chair and room stimuli. To find the contributions of each of the isolated stimuli to the representation of the complex scene, we fitted a linear model predicting the response to the complex scene based on the responses to the isolated stimuli. We found that throughout the face and body-selective areas, the contribution of both the face and the body to the representation of the multi-category scene was significant, whereas the contribution of the chair and the room was close to zero, effectively decluttering non-person stimuli. We conclude that the neighboring face and body-selective areas may functionally act as a "person-selective" area, while still enabling the system to bias the representation as needed to either the face, the body or the whole person according to task demands.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 659

Faces: Neural processes

Deficient functional MRI selectivity and connectivity in developmental prosopagnosia is specific to face regions

Talk Presentation - *Topic area: Faces: Neural processes*

Xian Li[12] (xianl@hms.harvard.edu), Joseph Arizpe[12], David Rothlein[13], Mike Esterman[13], Joseph DeGutis[12]; [1]Boston Attention and Learning Laboratory, VA Boston Healthcare System, [2]Harvard Medical School, [3]Boston University School of Medicine

Developmental prosopagnosia (DP) is characterized by severe facial recognition deficits, though it is currently debated whether only face-specific neural mechanisms are disrupted. A recent fMRI study found widespread decreases in category-selective (e.g., scene, body) regions in DPs (Jiahui et al., 2019), suggesting disruption may not be face-specific. To further evaluate neural deficits in DP, we scanned 23 DPs and 23 controls in task-based fMRI (dynamic localizer of faces/scenes/objects/bodies) and resting-state fMRI. In the task-based fMRI, DPs exhibited reduced face-selectivity across ventral face areas (anterior temporal lobe-ATL, fusiform face area-FFA, and occipital face area-OFA). This category-selectivity reduction was not found for scenes, bodies or objects in their respective regions, suggesting that the deficit of DP is limited to faces. Moreover, only the face area selectivity correlated with face recognition ability (average face-selectivity across OFA/FFA $r= .37$, $p<.05$), whereas scene, body, and objects area selectivity did not (all p's>.4). This shows that our measure of face-selectivity reflects behavioral performance on face identification. In the resting-state fMRI, DPs showed reduced functional connectivity (FC) across most region pairs within the face network. While FC within the body network showed some mild reduction, this reduction was not observed for FC within the scene or object network. Moreover, only the FC in the face network correlated with face recognition ability (average face-network FC $r=.46$, $p<.001$), while scene, body, and objects area FC did not (all p's>.13). This suggests that only resting connectivity between face regions is related to face recognition ability. Interestingly, we do not find a significant correlation between face-selectivity and face-network FCs, indicating they explain independent variance in face-recognition ability. Together, the fMRI selectivity and FC results, as well as their association with behavioral performance across all examined categories, suggests that DPs' functional neural deficits are largely limited to the faces.

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 827

Distinct identity information encoded in FFA and OFA

Talk Presentation - *Topic area: Faces: Neural processes*

Lucia Garrido[1] (garridolucia@gmail.com), Maria Tsantani[2], Katherine Storrs[3], Carolyn McGettigan[4], Nikolaus Kriegeskorte[5]; [1]City, University of London, [2]Birkbeck, University of London, [3]Justus Liebig University, [4]University College London, [5]Columbia University

The human brain contains several face-selective regions that consistently respond more to faces than other visual stimuli (Kanwisher et al., 1997), and activity in some of these regions can distinguish between different face identities. Studies using fMRI multivariate pattern analysis have shown that face identities can be distinguished based on their elicited response patterns in the fusiform face area (FFA), occipital face area (OFA), posterior superior temporal sulcus (pSTS), and anterior inferior temporal lobe (e.g. Nestor et al., 2011; Verosky et al., 2013; Anzelotti et al., 2014; Axelrod & Yovel, 2015; Tsantani et al., 2019). But do all these regions distinguish between identities in similar ways? We investigated what types of identity-distinguishing information are encoded in three face-selective regions: FFA, OFA, and pSTS. In an event-related fMRI study, 30 participants viewed videos of faces of famous individuals. We extracted brain patterns elicited by each face in each region and computed representational distances between different identities. Using representational similarity analysis (RSA; Kriegeskorte et al., 2008), we investigated which properties of the face identities best explained representational distances in each brain region. We built diverse candidate models of the differences between identities, ranging from low-level stimulus properties (pixel, GIST, and Gabor-jet dissimilarities), through higher-level image-computable descriptions (the OpenFace deep neural network), to complex human-rated properties (perceived similarity, social traits, and gender). We found marked differences in the information represented by difference face-identifying regions. Dissimilarities between face identities in FFA were well explained by differences in perceived similarity, social traits, gender and by the OpenFace network, trained to cluster faces by identity. In contrast, representational distances in OFA were mainly driven by differences in low-level image-based properties (pixel-wise and Gabor-jet dissimilarities). Our results suggest that, although FFA and OFA can both discriminate between identities, they encode distinct information about faces.

Acknowledgements: This work was supported by a Leverhulme Trust Research Grant (RPG-2014-392).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 536

Integrating Single-Unit and Pattern Codes in DCNNs Trained for Face Identification

Talk Presentation - *Topic area: Faces: Neural processes*

Connor J. Parde[1] (cxp126030@utdallas.edu), Y. Ivette Colon[1], Matthew Q. Hill[1], Alice J. O'Toole[1], Carlos Castillo[2]; [1]The University of Texas at Dallas, [2]University of Maryland Institute for Advanced Computer Studies

Historically, studies aimed at understanding neural codes have probed either individual neurons or patterns of neural activation. Here, we integrated these two levels of encoding by investigating individual simulated neurons (i.e., units) and high-level coding patterns in a deep convolutional neural network (DCNN) trained for face identification. These networks simultaneously encode identity, gender, and viewpoint (Parde et al., 2017) and allow for an investigation of representations at multiple scales. First, we measured individual units' capacity to distinguish identities, genders, and viewpoints ("attributes"). Second, we re-expressed face representations as directions in the high-dimensional space, quantified using principal component analysis (PCA), and measured PCs' capacity to distinguish face attributes. Coding capacity in individual units was measured by effect sizes in one-way ANOVAs for distinguishing identity (mean $R^2 = 0.71$, $SD = 0.016$), gender (mean $R^2 = 0.004$, $SD = 0.007$), and viewpoint (mean $R^2 = 0.002$, $SD = 0.002$). Although the effects for gender and viewpoint were small, they were of consistent magnitude across units, and predictions from the ensemble of units were accurate (gender-classification accuracy 92.3%, viewpoint estimation within 7.8 degrees). All units provided significant identity information, 71% provided gender information, and 50% provided viewpoint information (all $p < 0.05$, Bonferroni corrected). To investigate the organization of the three attributes in the PCA space, we computed the cosine similarity between each PC and directions diagnostic of identity, gender, and viewpoint separation. This analysis shows that the attributes are separated into subspaces such that identity information is encoded along axes that explain the most variance, followed by gender, and then viewpoint. Combined, these results indicate that the ensemble code that emerges from the DCNN organizes attributes semantically, though the individual units entangle this information. Therefore, these units cannot be interpreted as simple visual feature detectors in a traditional sense.

Acknowledgements: Research reported in this publication was supported by the National Eye Institute of the National Institutes of Health under award number R01EY029692.

This talk will be presented in Live Talk Session 4, Monday, 22 June, 4:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

Hello all! Thank you for stopping by. If you are interested in a pre-print of the work presented in the talk, click the following arXiv link: https://arxiv.org/pdf/2002.06274.pdf

Enjoy the conference!

Abstract ID: 1462

Layer-specific modulation of visual responses in human visual cortex by emotional faces

Talk Presentation - *Topic area: Faces: Neural processes*

Tina Liu[1] (tong.liu2@nih.gov), Jason Fu[1], Shruti Japee[1], Yuhui Chai[1], Leslie Ungerleider[1], Elisha Merriam[1]; [1]Laboratory of Brain and Cognition, National Institute of Mental Health, Bethesda, MD

Sensory processing can be enhanced by the emotional salience of stimuli. For example, fearful faces evoke stronger neural responses than neutral faces in multiple visual cortical areas in both monkeys and humans, including the primary visual cortex. Human and monkeys with amygdala lesions exhibit diminished neural modulation with facial valence, suggesting that the processing of facial valence in visual cortex is accomplished through feedback projections from the amygdala. We hypothesized that fMRI activity in the visual cortex during face viewing reflects a conjunction of both feedforward stimulus-driven geniculate-striate projections and feedback signals from the amygdala, and that these independent sources of input have distinct laminar profiles. In this study, we aimed to isolate and separately measure these two sources of input to visual cortex using ultra high-field, high-resolution fMRI. Participants viewed a series of face stimuli that were closely cropped and balanced for low-level visual properties. Face stimuli were presented for 900 ms with a 100 ms ISI, and were blocked by emotional valence (happy, fearful, neutral). Participants performed a gender judgement task unrelated to facial expression. We measured fMRI activity using vascular-space-occupancy (VASO) fMRI at 7T (0.8x0.8x0.8 mm), and gradient-echo BOLD fMRI at both 3T

and 7T (3x3x3 mm and 1.2x1.2x1.2 mm, respectively). We observed a robust and reliable facial valence effect in the amygdala, FFA, and V1 (Fig. 1A), replicating earlier findings. Measurements of the laminar profile of BOLD and VASO activity in V1 showed that the difference in response amplitude between fearful and neutral faces was only evident in the superficial cortical layers (Fig. 1B), the presumed site of amygdala feedback projections. Our results suggest that processing of facial valence in visual cortex is mediated through feedback projections to visual cortex, and that these inputs can be studied independent of the feedforward geniculate-striate projections.

Acknowledgements: The NIMH intramural Research Program.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The slides and the full text of this talk are available in the 'Supplement'.
Besides the chat box, feel free to contact me if you have any questions or feedback:
Email: tong.liu2@nih.gov

Abstract ID: 587

Selectivity to limbs in ventral temporal cortex decreases during childhood as selectivity to faces and words increases

Talk Presentation - *Topic area: Faces: Neural processes*

Marisa Nordt[1] (mnordt@stanford.edu), Jesse Gomez[2,3], Vaidehi S. Natu[1], Alex A. Rezai[1], Dawn Finzi[1], Kalanit Grill-Spector[1,2,4]; [1]Department of Psychology, Stanford University, Stanford, CA, [2]Neurosciences Program, Stanford University, Stanford, CA, [3]Department of Psychology, UC Berkeley, CA, [4]Wu Tsai Neurosciences Institute, Stanford University, Stanford, CA

Ventral temporal cortex (VTC) contains category-selective regions that are involved in perception. Childhood development of VTC is associated with increases in selectivity to behaviorally relevant categories such as faces and words. However, it is unknown whether the increase in selectivity emerges in voxels that are initially weakly specialized or if the selectivity of voxels is being repurposed. To investigate how changes in selectivity to different categories unfold in children over time, we investigated lateral ventral temporal responses to visual categories using longitudinal fMRI measurements spanning 2-5 years in 29 children (ages 5-17) comprising a total of 128 functional sessions. During fMRI participants viewed images of faces

(child/adult), body parts (limbs/bodies), characters (words/numbers), objects (cars/guitars), and places (houses/corridors) while performing an oddball task. Longitudinal measurements show a significant increase in the size of face-selective activation, which is larger in the right than left fusiform gyrus (FG), and in the size of word-selective activations in the left occipitotemporal sulcus (OTS, Fig 1). Surprisingly, in the same participants, we find a significant decrease in the size of limb-selective activations in the FG and OTS, bilaterally (Fig 1). However, selectivity to bodies, objects, numbers, and corridors in VTC did not change across childhood. Notably, increasing selectivity to faces and words was coupled with decreasing selectivity to limbs in the developing regions. These results provide evidence that childhood development is not only associated with increased selectivity to socially relevant categories such as faces and words, but also may involve recycling of selectivity: regions that are selective to limbs earlier in childhood become repurposed to represent faces and words.

Acknowledgements: DFG Fellowship NO 1448/1-1 to MN, NSF Graduate Research Development Program (DGE-114747), Ruth L. Kirschstein National Research Service Award (F31EY027201) to JG, training grant 5T32EY020485 to VN, NIH grant EY 022318 to KGS. We thank B. Jeska & M. Barnett for help in data acquisition & management.

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 152

Unraveling the neural representation of dynamic facial expressions through EEG-based decoding and movie reconstruction

Talk Presentation - *Topic area: Faces: Neural processes*

Tyler Roberts[1] (robertstyler192@gmail.com), Gerald Cupchik[1], Gloria Rebello[1], Jonathan S. Cant[1], Adrian Nestor[1]; [1]Department of Psychology, University of Toronto Scarborough

Extensive work has documented the perception of facial expressions, with particular focus on a handful of basic emotional expressions. However, the larger scope of facial expressions and their representational basis are less understood. Further, the neural processing of dynamic facial expression awaits clarification. Here, we address these challenges through EEG-based decoding and image/movie reconstruction.

Specifically, EEG data were collected from healthy adults who viewed 1-second videos displaying 24 dynamic facial expressions while performing an oddball task (i.e., angry expression recognition). Each stimulus started with a neutral expression and transitioned to displaying a peak expression over the course of ten 100ms frames. In addition, participants performed a behavioral pairwise rating task with the 24 expressions. EEG-based pattern analyses were carried out for expression decoding and, then, movie reconstruction was conducted based on the resulting decoding patterns. Our investigation reveals, first, that the representational space of facial expression derived from both behavioral and neural data is broadly, though not exclusively, accounted for by the classical dimensions of valence and arousal. Second, the temporal profile of EEG-based decoding shows a gradual increase after 350ms reaching a classification plateau between roughly 600-1200ms following stimulus onset. Further, a frame-by-frame analysis indicates that peak accuracy is reached after the midway point of stimulus presentation (i.e., at the 6-7th frame of a video), prior to peak expression display (i.e., the 10th frame). Third, movie reconstruction is successfully achieved from the EEG signal and, consistent with the decoding results, reconstruction accuracy is maximized after the midway point of stimulus presentation. Thus, our results shed light on the representational structure and the neural processing of dynamic facial expressions. Of note, they elucidate with an unprecedented level of detail the pictorial content of expression representations while also providing proof of concept for the possibility of EEG-based dynamic stimulus reconstruction.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 250

Faces: Real world, experience

Distinct face movements boost recognition of facial expressions of emotions

Talk Presentation - *Topic area: Faces: Real world, experience*

Tommaso Querci[1] (2356605q@student.gla.ac.uk), Yaocong Duan[1], Robin AA Ince[1], Chaona Chen[1], Lotta K Peussa, Oliver GB Garrod[1], Philippe G Schyns[1], Rachael E Jack[1]; [1]University of Glasgow

Human social communication critically relies on the accurate interpretation of nonverbal cuessuch as dynamic facial expressions, with confusions and misunderstands causing substantial negative consequences. Here, we reveal for the first time the specific dynamic face movements that drive high accuracy in emotion recognition and those which cause significant confusions. Three hundred participants (Western, 150 females, mean: 21.6, SD: 2.9 years) categorized a sub-set of 720 dynamic facial expressions models of the six classic emotions, each comprising a specific set of face movements (called Action Units – AUs; Ekman & Friesen, 1976) by emotion in a 6AFC task. To identify the specific face movements that give rise to high emotion recognition accuracy, and those that cause confusions, we measured the relationship between each AU and the participants' recognition accuracy on each trial (i.e., correct or incorrect) using an information-theoretic analysis basedon Mutual Information (Ince et al., 2017). Results showed that, for each emotion, a specific subset of dynamic face movements drive high recognition accuracy. Specifically, recognition of fear and surprise – which are often confused – is boosted by distinct face movements: eyebrow raising (Outer/Inner Brow Raiser–AU1,2) and wide mouth opening (Jaw Drop–AU26) in surprise, and brow lowering (Brow Lowerer–AU4) and lateral mouth stretching (Lip Stretcher–AU20) in fear. A similar pattern characterized the often-confused emotions, disgust and anger – recognition of anger is boosted by mouth opening (e.g. Lip Funneler–AU22, Mouth Stretch–AU27), while disgust is boosted by nostril (Nasolabial Deepener–AU11) and eye constrictions (e.g., Cheek Raiser–AU6). Analyses of the face movements that boost recognition accuracy across emotions showed that they are highly distinct, suggesting that recognition boosters are category specific. Here, we modelled the specific face movements that drive high recognition accuracy of emotions and support optimal social communication, with implications for designing communicative digital avatars and social robots.

Acknowledgements: ERC: 304001 ERC FACESYNTAX, The Economic and Social Research Council (ES/K001973/1 and ES/K00607X/1), British Academy (SG113332)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1039

Improving the ability to interpret eye gaze cues in autistic adolescents: A serious game intervention

Talk Presentation - *Topic area: Faces: Real world, experience*

Jason W. Griffin[1] (jxg569@psu.edu), Joshua M. Smyth[1], Charles F. Geier[1], K. Suzanne Scherf[1]; [1]The Pennsylvania State University

Abnormal visual attention to faces and difficulty interpreting eye gaze cues are core deficits of autism and have widespread consequences for social communication. Specifically, autistic people have difficulty computing the trajectory of eye gaze, understanding the referential nature of gaze, and assigning social relevance to gazed-at objects. We developed a “serious” computer game intervention (SAGA: Social Games for Autistic Adolescents) intended to improve looking time to faces and understanding about using eye gaze cues via learning within a narrative storyline and adaptive difficulty progression. Participants interact with animated human characters and discover that eye gaze cues are useful for guiding their own goal-directed behavior to solve problems in the game, simulating how these cues are discovered and used in the real world. We evaluated the effectiveness of SAGA in a hybrid Phase 1 and 2 randomized clinical trial with intervention (N=20) and waitlist control (N=20) groups of autistic adolescents. The intervention group was instructed to play the game at home 90-min/week for 2 months. SAGA was feasible, acceptable (high participant compliance), and generally safe (no adverse events). Participants completed a standardized laboratory gaze perception task pre- and post- intervention with accuracy and eye-tracking metrics as outcome measures. Participants viewed an image of a person in a complex scene looking at a target object (TO); they had to identify the TO from a list of 4 plausible alternatives from the scene. At pre-test, there was no association between looking time to faces and accuracy in either group. At post-test, however, the intervention group showed a positive association between looking time to faces and TO accuracy (no association in controls). Mean looking time to faces did not increase from pre- to post-intervention timepoints. Therefore, we conclude that SAGA improved social visual attention to faces for the purpose of interpreting eye gaze cues.

Acknowledgements: This work was supported by grants from the National Institute of Mental Health R61/33 MH11-624

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have any further questions, feel free to email me at jxg569@psu.edu

Abstract ID: 1346

Intracranial electroencephalography reveals real world vision in humans is a contextually modulated, distributed, and active sensing process

Talk Presentation - *Topic area: Faces: Real world, experience*

Arish Alreja[1], Vasu Sharma[1], Michael Ward[2], Mark Richardson[3,4], Max G'Sell[1], Louis-Philippe Morency[1], Avniel Ghuman[2]; [1]Carnegie Mellon University, [2]University of Pittsburgh, [3]Harvard University, [4]Massachusetts General Hospital

Neural correlates of true, real world vision are almost entirely unknown. The lack of understanding of real world vision is particularly problematic in the context of face perception, where passively viewing static, unfamiliar, and isolated faces briefly presented at fixation bears little resemblance to the richness of real world interpersonal interactions. In the real world there is context, familiar faces in relatively stable positions, and volitional eye movements are used to actively sample information. To begin filling this gap in knowledge, we simultaneously recorded intracranial electroencephalography (ECoG), eye-tracking and videos of scenes being viewed by human subjects over hours of natural conversations with friends, family and experimenters. Annotating these videos on a frame-by-frame basis using computer vision models, we delineated each fixation as being on a face or other object during natural behavior. Multivariate classification revealed that spatiotemporal signatures of activity in each subject were sensitive to whether they were looking at faces or objects. Notably, a far greater portion of cortex was involved in face processing during real world vision than in a traditional experimental paradigm. Additionally, neural activity during object fixations could be used to classify whether a face was present elsewhere in the visual field or not, demonstrating contextual modulation of spatiotemporal patterns of neural activity. The neurodynamics of eye movement guidance were then examined by showing that what patients were going to look at next could be classified. Specifically, not only did brain activity predict where in space subjects would saccade, but also whether or not the next saccade would be to a face. These findings demonstrate that richness of real world visual perception is captured from the neurodynamics of visual perception, highlighting the power of invasive neural recordings in humans in combination with real world behavior as a platform for studying visual neuroscience.

Acknowledgements: NIH 1R21EY030297, NSF 1734907, NIH R01MH107797

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hello. Thank you for your interest in this project. If you have feedback, suggestions, any questions I can help answer or anything else you'd like to share, please let me know at 'aalreja at andrew dot cmu dot edu'.

Abstract ID: 1532

Properties of familiar face representations: No evidence for qualitative differences between personal and media-based familiarity

Talk Presentation - *Topic area: Faces: Real world, experience*

Holger Wiese[1] (holger.wiese@durham.ac.uk), Georgina Hobden[1], A. Mike Burton[2], Andrew W. Young[2]; [1]Durham University, [2]University of York

Humans are highly efficient at recognising familiar faces, independent of whether these faces are known from real life (i.e., personally familiar faces) or via media (e.g., celebrity faces). It is unclear, however, whether recognition in these two cases relies on the same type of facial representation, and some researchers have suggested qualitative differences between media-based and real-life face familiarity. Here, we used event-related brain potentials (ERPs) to test whether early visual recognition (as reflected in the N250 familiarity effect; 200-400 ms after stimulus onset) and later stages of integrating visual with additional person-related information (as reflected in the Sustained Familiarity Effect [SFE]; 400-600 ms) are different for real-life versus media-based familiarity. In two experiments, we presented multiple "ambient" face images (varying naturalistically in lighting, viewing-angles, emotional expressions etc.) of a highly personally familiar person, of the participant's favourite celebrity, and of an unfamiliar person. We consistently observed clear N250 familiarity effects, with more negative amplitudes for both personally familiar and favourite celebrities relative to unfamiliar faces. A similar pattern was observed in the subsequent SFE time window, which additionally showed larger familiarity effects for personally familiar relative to favourite celebrity faces (Experiment 1). In a third experiment, we compared favourite celebrities with disliked celebrities to test for a potential influence of valence on ERP familiarity effects. Again, clear effects were observed for all familiar face IDs, with a reduced SFE for disliked relative to favourite celebrities. Overall these findings suggest that ERP familiarity effects are not qualitatively different for personal versus media-based familiarity. Instead, increasing familiarity may result in more robust representations that allow recognition from increasingly variable images and irrespective of the valence of one's personal feelings.

This talk will be presented in Live Talk Session 5, Monday, 22 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 493

Supervised learning enables generalization across dissimilar appearances of the same identity by conceptual rather than perceptual mechanisms

Talk Presentation - *Topic area: Faces: Real world, experience*

Galit Yovel[1], Maya Gotlieb[1], Naphtali Abudarham[1], Yarden Shir[1]; [1]Tel Aviv University

Humans effortlessly generalize across highly dissimilar appearances of the same identity, as well as discriminate similarly looking different identities for familiar but not for unfamiliar faces. Here we propose that this remarkable performance is enabled by supervised learning, which links perceptually dissimilar appearances of the same identity to the same label (e.g., name). These learned appearances are stored in memory as separated representations, that are linked to the same identity label, and can therefore be matched conceptually rather than perceptually. To test this hypothesis, we first presented subjects with pairs of perceptually dissimilar or perceptually similar faces during supervised (i.e. with labels) or unsupervised (i.e., without labels) learning task, and found that perceptually different faces were matched to the same identity following supervised but not unsupervised learning. Next, we examined whether two perceptually different appearances of the same identity are stored as a single prototype, or multiple sub-prototypes. We hypothesized that in a single prototype representation, an average face of the learned faces would be recognized as the learned identity, but not in multiple sub-prototype representation. To test this hypothesis, participants learned pairs of perceptually similar or dissimilar faces of the same identity with name labels. During test, they were presented with the learned faces, and also with their unlearned average faces. For perceptually similar pairs, the average face was recognized as the learned identity, indicating a single prototype for perceptually similar faces. However, for the perceptually dissimilar faces, their average face was not recognized, indicating that perceptually dissimilar faces were represented by separate prototypes, that are nevertheless linked to the same identity conceptually. This representation takes advantage of the conceptual information that is typically associated with familiar faces during learning and retrieval, to account for human remarkable recognition of familiar faces.

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 501

Faces: Social cognition

A face you can trust: Iterated learning reveals how stereotypes of facial trustworthiness may propagate in the absence of evidence

Poster Presentation - *Topic area: Faces: Social cognition*

Stefan Uddenberg[1], Bill Thompson[1,2], Madalina Vlasceanu[1], Thomas L. Griffiths[1], Alexander Todorov[1];
[1]Princeton University, [2]University of California, Berkeley

When we look at someone's face, we rapidly and automatically form robust impressions of how trustworthy they appear. Such impressions are vitally important, as our everyday decisions of whom to trust can have profound impacts on collective societal outcomes. Yet while people's impressions of trustworthiness show a high degree of reliability and agreement with one another, evidence for the accuracy of these impressions is extremely weak. How do such appearance-based biases survive in the face of weak evidence? We explored this question using an iterated learning paradigm, in which memories relating facial and behavioral trustworthiness were passed through many generations of participants. Stimuli consisted of pairs of computer-generated people's faces and exact dollar amounts that those fictional people shared with partners in a trust game. Importantly, the faces were designed to vary considerably along a dimension of facial trustworthiness. Each participant learned (and then reproduced from memory) some mapping between the faces and the dollar amounts shared (i.e., between facial and behavioral trustworthiness). Much like in the game of "telephone", their reproductions then became the training stimuli initially presented to the next participant, and so on for each transmission chain. Critically, the first participant in each chain was taught a completely random mapping between facial and behavioral trustworthiness. Nevertheless, within only a few generations of participants, stereotyped patterns of transmission behavior spontaneously emerged from the initially noisy relationship. The most common of these patterns was a positive linear relationship between facial and behavioral trustworthiness, consistent with the commonly held stereotype. However, some chains yielded other simple patterns, such as negative linear relationships, or simple clusters of low/high facial/behavioral trustworthiness. These results demonstrate the power of facial stereotypes, and the ease with which they can be propagated to others, even in the absence of any reliable signal from the environment.

Acknowledgements: SU was supported by supported by the National Institutes of Health (T32 #MH065214)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1735

Black is angry, White is scared: Evaluation of pain expressions in White and Black faces

Poster Presentation - *Topic area: Faces: Social cognition*

Francis Gingras[1,2] (francis.gingras16@gmail.com), Andréa Deschênes[2], Daniel Fiset[2], Stéphanie Cormier[2], Hélène Forget[2], Marie-Pier Plouffe-Demers[1,2], Caroline Blais[2]; [1]Université du Québec à Montréal, [2]Université du Québec en Outaouais

Detecting pain in others is a social skill of utmost importance (Williams, 2002). In countries where the racial majority is of White-European descent, pain experienced by Black individuals is underestimated. This tendency may in part take root in perceptual processes involved in pain facial expression recognition (Mende-Siedlecki et al., 2019). In the present study, we verified how people represent the appearance of pain expressions in Black and White faces. We extracted the mental representations of 30 White-Canadian and 30 Black-African participants using Reverse Correlation (Mangini & Biederman). Participants rated perceived pain in White and Black faces embedded in white sinusoidal noise. The average mental representations obtained in each ethnic group with each face ethnicity were then rated by independent participants on the degree to which they expressed five basic emotions and pain. Two main results were obtained. First, the overall emotional intensity of the mental representations extracted in Black-African participants was lower than the one of White-Canadians ($F(1, 52)=5.02$, $p=.03$). Second, the mental representation of pain, when expressed in a Black face, was perceived as less in pain ($t(54)=8.3$, $p<.001$) and more angry ($t(54)=-3.6$, $p=.001$) than when expressed in a White face. Moreover, when pain was expressed in a White face, it was perceived as more sad ($t(53)=2.4$, $p=.02$) and scared ($t(54)=3.4$, $p=.001$). These results suggest that at least two perceptual factors may be linked with the underestimation, by White individuals, of the pain experienced by Black individuals. First, White-Canadians expect pain expressions to be more intense than Black-Africans. These higher expectations may lead them to erroneously assume that pain experienced by Black individuals is of lower intensity. Second, while pain expressions in White faces include other emotions associated with approachability, pain expression in Black faces appear angrier, an emotion that may discourage helping behavior.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1442

Does relationship quality with family or peers predict facial recognition abilities in emerging adults?

Poster Presentation - *Topic area: Faces: Social cognition*

Myles Arrington[1], K. Suzanne Scherf[1]; [1]Psychology Department, Pennsylvania State University

Some work indicates that social competence is related to individual differences in face recognition (FR) abilities. For example, extraversion and empathy are reportedly related to better FR performance, while social anxiety predicts worse performance (Davis et al., 2011). This work does not account for dynamics of specific social relationships or changes in these relationships through development. Most experimental work is executed with emerging adult participants (ages 18-25 yrs) who are undergoing a developmental transition such that peers predominate the social networks that family once did. Here, we evaluated how conflict and social support with family versus peers are associated with face and object recognition abilities in emerging adults (N=118). We used the Network of Relationships Inventory to measure positive and negative relationship quality among family members (mother, father, sibling, optional relative) and peers (same- and opposite-sex best friends, romantic partner – current/most recent). Face recognition for emerging adult faces was assessed using the long form of the Cambridge Face Memory task, with male (M-CFMT) (Duchaine & Nakayama, 2006; Russel et al, 2009) and female (F-CFMT) (Scherf et al., 2017) faces. Object recognition was tested using the Cambridge Car Recognition Task. In contrast to predictions from the literature, regardless of whether from family or peers, enhanced social support did not predict better FR abilities. However, increasing conflict with family members, but not peers, predicted better face, but not car, recognition abilities in both FR tasks. One possible interpretation of these findings is that higher family conflict may influence vigilance of face processing, including recognition abilities. This interpretation resonates with research showing that family conflict influences face emotion perception (Gollier-Briant et al, 2016). This research also adds to the literature evaluating whether FR predicts differences in social competence or social competence predicts FR.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1502

Does within group diversity always lead to better group recognition?

Poster Presentation - *Topic area: Faces: Social cognition*

Rose-Marie Gervais[1], Jessica Tardif[1], Frédéric Gosselin[1]; [1]University of Montreal

The wisdom-of-crowds effect is the tendency of a group to perform better than most individuals and sometimes better than the best individual within the group. This phenomenon was first demonstrated for tasks that required estimations of weights or sizes (Bruce, 1935; Galton, 1907; Gordon, 1924). However, a ubiquitous observation is that certain groups perform better than others, and one factor that appears to play a role in obtaining a good group performance is diversity. For example, simulations have shown that groups of diverse algorithms can outperform groups made of the best algorithms (e.g. Hong & Page, 2004). Here, we evaluated whether group diversity in the individual members' use of information for face identification—measured using the Bubbles method—is also associated with group performances in face recognition—measured using the Cambridge Face Memory Test (CFMT). We randomly generated groups of sizes 2 to 11 from a sample of 102 participants. Group performance was obtained by averaging the result of the application of the majority rule on all CFMT trials. Group diversity was indexed by the inverse of the average Pearson correlation between the group members' standardized classification images. Our main result is that, contrary to what we expected from the literature, diversity in use of information is negatively correlated with group performance (across group sizes: $r = -.23$; $p < .05$, two-tailed, Bonferroni-corrected). This seems to stem from inefficient human strategies for face identification being more diverse than efficient ones and, therefore, from diverse groups containing more unskilled than skilled participants. In any case, our results show that factors other than diversity can be important for predicting group performances.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1243

Good deeds enhance beauty, but beauty does not affect goodness of deeds

Poster Presentation - *Topic area: Faces: Social cognition*

Chen Zhao[1] (cz1646@nyu.edu), Aenne Brielmann[1], Denis Pelli[1,2]; [1]New York University, Department of Psychology, [2]Department of Psychology and Center for Neural Science

The relation of morality to aesthetics matters in many fields, including social, perceptual, and cognitive psychology. Moral and aesthetic judgments mutually influence one another: People's physical attractiveness influences how honest and trustworthy they appear, and people's character influences how we judge their appearance. However, previous studies assessed people's traits but neglected the behaviors associated with those traits. The current study aimed to explore the mutual influence between facial attractiveness and morality of the person's actions. We used a photo-caption paradigm with two complementary tasks. In the beauty-rating task, we manipulated the morality of the behavior described in the caption (moral or immoral), and the participant rated the facial attractiveness of the actor in the photo; in the morality rating task, we manipulated facial attractiveness (attractive or unattractive), and the participant rated the morality of the behavior. We recruited 78 participants on Amazon Mechanical Turk. The results show that morality ratings do not differ for attractive ($M = 2.99$, $SD = 0.56$) versus unattractive faces ($M = 2.95$, $SD = 0.56$; $t(54) = 0.25$, $p = 0.805$). In contrast, attractiveness ratings are higher for actors described as behaving morally ($M = 4.92$, $SD = 0.74$) than for those described as behaving immorally ($M = 3.82$, $SD = 0.93$; $t(52) = 4.76$, $p < 0.001$). This means that the Halo Effect, i.e., more favorable judgment of an attractive person's traits, does not extend to judgments of a person's action. Apparently, attractiveness does not justify immoral behavior. Morality affects attractiveness, but attractiveness does not affect morality.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 871

Measuring race bias in face recognition algorithms: a multi-factor assessment

Poster Presentation - *Topic area: Faces: Social cognition*

Jacqueline G. Cavazos[1] (jacqueline.cavazos@utdallas.edu), P. Jonathon Phillips[2], Carlos D. Castillo[3], Alice J. O'Toole[1]; [1]The University of Texas at Dallas, [2]National Institute of Standards and Technology, [3]University of Maryland Institute for Advance Computer Studies

Previous generations of face recognition algorithms show differences in accuracy for faces of different races (race bias) (O'Toole et al., 1991; Furl et al., 2002; Givens et al., 2004; Phillips et al., 2011; Klare et al., 2012). Whether newer deep convolutional neural networks (DCNNs) are also race biased is less well studied (El Khiyari et al., 2016; Krishnapriya et al., 2019). Here we present methodological considerations for measuring underlying race bias. We consider two key factors: data-driven and scenario modeling. Data-driven factors are driven by the data itself (e.g., the architecture of the algorithm, image quality, image population statistics). Scenario modeling considers the role of the "user" of the algorithm (e.g., threshold decisions and demographic constraints). To illustrate these issues in practice, we tested four face recognition algorithms: one pre-DCNN (A2011; Phillips et al., 2011) and three DCNNs (A2015; Parkhi et al., 2015), (A2017b; Ranjan et al., 2017), (A2019; Ranjan et al., 2019) on East Asian and Caucasian faces. First, for all four algorithms, the degree of race bias varied as a function of the identification decision threshold. Second, for all algorithms, to achieve equal false accept rates (FARs), Asian faces required higher identification thresholds than Caucasian faces. Third, dataset difficulty affected both overall recognition accuracy and race bias. Fourth, demographic constraints on the formulation of the distributions used in the test, impacted estimates of algorithm accuracy. We conclude with a recommended checklist for measuring race bias in face recognition algorithms.

Acknowledgements: National Eye Institute Grant 1R01EY029692-01 to A. O'T; CDC was supported by JANUS program Intelligence Advanced Research Projects Activity, R&D Contract, No. 2014-14071600012

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 553

Social trait perception is structured by a latent composition of 3D face features

Poster Presentation - *Topic area: Faces: Social cognition*

Laura B. Hensel[1], Jiayu Zhan[1], R. Thora Bjornsdottir[1], Oliver G.B. Garrod[1], Philippe G. Schyns[1], Rachael E. Jack[1]; [1]University of Glasgow

First impressions of key social traits such as trustworthiness and competence are often based on rapid judgments of facial appearance, with substantial downstream consequences for individuals. A challenge remains to understand the specific face features that drive social perception. Here, we address this by showing that two major models of social perception (warmth/competence, Fiske et al., 2006; trustworthiness/dominance, Oosterhof & Todorov, 2008) are structured by a set of latent features that are shared across social traits, plus a set of trait-specific features that distinguish them. Specifically, we used a novel 3D face generator (Zhan, Garrod, van Rijsbergen, & Schyns, 2019), reverse correlation, social trait perception, and a data reduction technique to model these shared and unique features. Thirty participants (15 women, white, Western, 18-35 years) each viewed 2400 randomly generated 3D face identities and rated each on the four bipolar social trait dimensions (e.g., 'very submissive' to 'very dominant') in separate tasks. To identify the specific 3D face features that elicit these perceptions, we linearly regressed the 3D face information presented on each trial and the participant's responses, producing 360 3D face models per trait. Next, to identify their features, we reduced all 3D face models with non-negative matrix factorization and mapped the resulting feature combinations that characterize each trait. Dominance and competence share an inwards change of the eyebrow region, also shared with cold and untrustworthy. Thus, a single feature can be shared across traits, including those thought to be unrelated with each other. Trustworthiness and warmth similarly share many features, predominantly around the mouth (i.e., upturned mouth corners). Our results reveal a compositionality of social trait perception, driven by shared 3D shape features plus unique accents, which have the generative capacity of designing digital social avatars and robots that convey first impressions of key social traits.

Acknowledgements: European Research Council (FACESYNTAX; 75858) and Wellcome Trust (Senior Investigator Award, UK; 107802) supported this work.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

You can contact me via email: 2039067h@student.gla.ac.uk
And follow me on twitter: @LBHensel
If you would like to talk to me about my work in person, please join one of my presenter conferences or contact me about a separate meeting!

Abstract ID: 1365

The Effect of Implicit Racial Bias on Recognition of Own- and Other-Race Faces

Poster Presentation - *Topic area: Faces: Social cognition*

Tobiasz Trawinski[1] (tobiasz.trawinski@nyu.edu), Araz Aslanian[1], Olivia S. Cheung[1]; [1]New York University Abu Dhabi

Previous research has established a possible link between recognition performance, individuation experience, and implicit racial bias of other-race faces. However, it remains unclear how implicit racial bias might influence other-race face processing in observers with relatively extensive individuation experience with the other race. Here we examined how recognition of own- and other-race faces might be modulated by observers' face recognition ability, individuation experience, and implicit racial bias. Caucasian participants (N=53) completed a memory task for Caucasian and Asian faces, an implicit association test, a questionnaire on individuation experience towards Caucasians and Asians, and a face recognition ability test. Perhaps surprisingly, overall the Caucasian participants showed significantly better recognition performance for other- than own-race faces. More importantly, while the memory performance for own-race faces was only positively predicted by increased face recognition ability, the recognition performance for other-race faces were positively predicted by increased face recognition ability, individuation experience with Asians, and negatively predicted by increased positive bias towards Asians, which was modulated by an interaction between face recognition ability and implicit bias, with the effect of implicit bias observed predominantly in observers with high face recognition ability. Moreover, while no significant modulation of implicit bias was observed in eye movements on the other-race faces during the memory task, we found significant differences among the locations of the first three fixations when participants learned the own- vs. other-race faces, with a tendency of focusing on the upper face parts for other- than own-race faces, which might be related to the better overall performance for other- than own-race faces. Taken together, these findings suggest the complexity in understanding the perceptual and socio-cognitive influences on the other-race effect, and that observers with high face recognition ability may more likely to allocate spare cognitive resources involuntarily to evaluate racial factors when recognizing other-race faces.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1701

What does an androgynous face look like?

Poster Presentation - *Topic area: Faces: Social cognition*

Leigh Greenberg[1] (greenbee@mcmaster.ca), Caroline Blais[2], Daniel Fiset[2], Patrick Bennett[1], Allison Sekuler[1,3,4]; [1]McMaster University, [2]University of Quebec Outaouais, [3]Baycrest Health Sciences, [4]University of Toronto

Studies of the perception of face gender often assume that androgynous faces lie near the midpoint of a continuum that includes “femininity” and “masculinity” on either extreme. For example, androgynous face stimuli are often generated by morphing male and female faces with equal weighting. However, the validity of using morphs to represent all androgynous faces has yet to be tested; the current study addresses that gap. Undergraduate students (n=185) used a 5-point scale to independently rate faces’ levels of femininity, masculinity, and androgyny. A subset of these faces were rated, on average, at least “somewhat androgynous” (i.e., mean rating >3). We classified these faces as natural (non-morphed) androgynous faces. We recruited an additional 25 subjects to rate the same set of non-androgynous and androgynous natural faces, along with a new set of morphed androgynous faces that were created from faces previously rated as strongly feminine or strongly masculine (i.e., faces with mean femininity or masculinity ratings >4). We found that the two types of androgynous faces were given similar androgyny ratings and masculinity ratings, but were given significantly different femininity ratings. The natural androgynous faces were perceived as more feminine than masculine, whereas the morphed androgynous faces were perceived as more masculine than feminine. This result suggests that morphing male and female faces may create androgynous faces that differ in important ways from natural androgynous faces. Further, the fact that the two groups of androgynous faces had unequal masculinity and femininity ratings suggests that androgynous faces do not all fall at the midpoint of a masculinity-femininity continuum. We are currently investigating the stimulus characteristics that distinguish natural and morphed androgynous faces, and that are correlated with various gender judgments.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1565

Motion

A causal inference model for the perception of complex motion in the presence of self-motion

Talk Presentation - *Topic area: Motion*

Sabyasachi Shivkumar[1,2] (sshivkum@ur.rochester.edu), Gregory C. DeAngelis[1,2], Ralf M. Haefner[1,2]; [1]Brain and Cognitive Sciences, University of Rochester, [2]Center for Visual Science, University of Rochester

Our subjective percept of object motion has been shown to systematically differ from the observed velocity on the retina due to motion of other objects (“hierarchical grouping”: Gershman et al. 2016) or due to our self-motion (“flow-parsing”: Warren et al. 2009). We present a hierarchical Bayesian model (and new data from two psychophysics experiments to support it) to unify our understanding of how motion context influences object motion perception. The recurring motif in our hierarchical model is the decomposition of object motion into group motion and motion relative to the group. The prior over velocities is a mixture of a delta function at zero velocity and a Gaussian centered at zero. This modification of the classic slow-speed prior (Stocker et al. 2006) effectively performs "causal inference" (Kording et al. 2007) over whether the object is stationary or moving and leads to a hierarchical "chunking" into groups and supergroups (of groups) when applied to multiple visual elements. Our model infers individual motion relative to a group, and accounts for inferred self-motion based on optic flow. In the two experiments, fixating subjects report the perceived direction of a peripheral object (patch of dots) using a dial. The object is surrounded by moving groups of dots in one experiment, and optic flow dots simulating self motion in the other experiment. Subject responses are systematically biased depending on the difference between object and group velocity: (a) towards group velocity for small differences, (b) away from group velocity for large difference, and (c) either of the two for intermediate differences, varying from trial to trial and reflecting the subject’s uncertainty over the correct causal model.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1631

But still it moves: static image statistics underlie how we see motion

Talk Presentation - *Topic area: Motion*

Reuben Rideaux[1] (reuben.rideaux@gmail.com), Andrew E Welchman[1]; [1]University of Cambridge

How does experience shape what we see? Bayesian theories of vision assume that we systematically accumulate information about the statistical probability of particular events in the environment. A classic example being the use of a ‘slow world’ prior that is premised on close-to-zero net motion of the environment. Specifically, humans are thought to have internalised knowledge of environmental motion statistics, and to use this prior information to shape and guide perceptual estimates, thereby accounting for

perceptions, and misperceptions, of movement. Here we explore these ideas by systematically manipulating the training inputs to a neural network to discover and test the drivers of motion perception. We find that diverse motion characteristics are largely explained by the statistical structure of natural images, rather than motion per se. In particular, we show how neural and perceptual biases for cardinal motion directions result from the orientation structure of natural images. We reveal a novel interdependency between speed and direction preferences in MT neurons and show how this is explained by the autocorrelation in natural images. We demonstrate that motion illusions spontaneously emerge from the necessity to estimate the velocity of natural image sequences, and show how these can all be computationally explained within a biologically plausible system. Finally, we demonstrate that speed and image contrast are related quantities, and using behavioural tests, we show that it is knowledge of this speed-contrast association that explains why observers underestimate the speed of low contrast image sequences; that is, rather than the distribution of movements in the environment (i.e., the 'slow world' prior) as premised by Bayesian accounts. Together we provide an exposition of motion speed and direction estimation by biological brains, and offer concrete predictions for future neurophysiological experiments.

Acknowledgements: The work was supported by the Leverhulme Trust (ECF-2017-573), the Issac Newton Trust (17.08(o)), and the Wellcome Trust (095183/Z/10/Z).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 1:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 275

Nature-inspired noise model accounts for a broad range of motion phenomena

Talk Presentation - *Topic area: Motion*

Hyun-Jun Jeon[1] (hjjeon@unist.ac.kr), Duje Tadin[2,3], Oh-Sang Kwon[1]; [1]Department of Human Factors Engineering, Ulsan National Institute of Science and Technology, [2]Center for Visual Science & Dept. of Brain and Cognitive Sciences, University of Rochester, [3]Department of Ophthalmology, University of Rochester

Background: According to the optimal object tracking model (Kwon, Tadin, & Knill, 2015, PNAS), the visual system integrates noisy sensory inputs with a forward model to estimate positions and motions of moving objects. The model provides a unifying account of a wide range of visual phenomena related to the integration of motion and position signals. However, illusory perception of flicker-defined motion (Mulligan & Stevenson, 2014, VSS) provides a counterexample. The flicker-defined motion appears to jump when it moves continuously, which conflicts with the prediction of the optimal tracking model. Model: The propagation noise of a tracking model represents the system's assumption of the random changes of velocity, and conventionally it was assumed to follow a Gaussian distribution. Considering that various natural movements follow a fat-tailed distribution (Kleinberg, 2000, Nature), we built a model that assumes a fat-tailed propagation noise and found that the model can predict jumping percepts of the flicker-defined motion. Experiment: We asked participants to report the perceived jumping frequency across five object speeds (3.7, 5.5, 9.2, 11°/s), two pattern speeds (1X object speed, 2X object speed) and two eccentricities (11, 16°) by adjusting the jumping frequency of a probe stimulus. Results show that the jumping frequency increases as (a) the object speed increases, (b) the relative pattern speed increases, or (c) the eccentricity decreases. Results are consistent with the prediction of the fat-tailed model and rule out the possibility that the observed jumping percept is due to periodic attentional sampling. Moreover, the same model can account for a range of other motion phenomena. Conclusion: The fat-tailed propagation noise model can account for a broader range of perceptual phenomena than the model based on commonly used Gaussian noise. Evidently, the visual system assumes fat-tailed propagation noise, noise that closely mirrors statistics of object movements observed in nature.

Acknowledgements: NRF-2018R1A2B6008959 to O.-S. K

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1033

Weak integration of form and motion in two-stream CNNs for action recognition

Talk Presentation - *Topic area: Motion*

Yujia Peng[1] (yjpeng@g.ucla.edu), Tianmin Shu[2], Hongjing Lu[1]; [1]University of California, Los Angeles, [2]Massachusetts Institute of Technology

Human-level performance in action recognition has been achieved by the two-stream convolutional neural networks (CNN), which include a spatial CNN for analyzing appearance information in images, a temporal CNN for analyzing optical flow information in body movements, and a fusion module to integrate the two processes. We examine the contributions of the three modules to the recognition of actions in point-light and skeletal displays. In simulation 1, we trained the two-stream CNNs with raw videos and skeletal displays of human actions and tested whether the model can recognize actions in the point-light display. We found that the final recognition from the fusion module showed worse performance than did the temporal CNN alone, suggesting the model overweights appearance features extracted from the spatial CNN than motion features from the temporal CNN. Simulation 2 used walking actions to examine whether walking directions impact on facing direction discrimination. The temporal CNN showed better discrimination for in-place walking than for backward walking and moonwalk. In contrast, the final decision from the fusion module did not show this effect. Simulation 3 trained the two-stream CNNs to discriminate three types of walking actions, i.e., forward walking, backward walking, and moonwalk. The temporal CNN of motion processing achieved higher accuracy (.82) than the final recognition from the fusion module (.6). Further generalization test showed that the temporal CNN is sensitive to the causal direction of limb movements and body displacements, but the final decisions from the fusion module fail to show the sensitivity. We conclude that two-stream CNNs extract important form and motion features from action stimuli, however, the integration of the two processes in the fusion module is suboptimal to account for human performance in action recognition and understanding.

Acknowledgements: NSF grant BCS-1655300

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

For any questions, please email yjpeng@ucla.edu. Thank you!

Abstract ID: 615

Motion: Biological motion, flow, eye movements

A huge individual difference in perceiving sex and gender of point light walkers

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Chihiro Asanoi[1] (chihiroa@odalab.org), Koichi Oda[2]; [1]Tokyo Woman's Christian University Graduate School of Humanities and Sciences, [2]Tokyo Woman's Christian University School of Arts and Sciences

Previous studies have shown that a human observer could perceive a person's sex based on point-light walkers (PLW). Kozlowski et al. (2016) asked observers to identify not only PLW's biological sex (male or female) but also its gender (masculine or feminine); their results revealed that perceptual sex and gender did not match completely. This study aims at examining this dissociation more in detail. It also investigates the relationship between gender perception and sex perception and how the latter could be explained by two perceived genders. Thirty-three university students (17 male, 16 female) observed the side view of 40 PLWs (20 male, 20 female) on a screen. The experiments consisted of three blocks. Observers were asked to report one of three different perceptual attributes on each block; whether they perceived the PLW to be(1) masculine or not, (2) feminine or not, and (3) male or female. In each block, PLWs were shown 10 times in random order, totaling 1200 trials. On the basis of the correlation coefficient between the frequency of reporting the PLW to be masculine and feminine, the observers were classified into three groups whose (1) perceptual masculinity and femininity were negatively correlated, (2) independent, and (3) positively correlated, the latter two of which were completely unexpected. Multiple linear regression analysis of sex perception showed that the regression coefficient was larger for femininity than for masculinity in 70% of observers. This suggests that the sex perception of PLWs could relatively depend on perception of femininity. This study replicated the dissociation between gender perception and sex perception from PLWs, and found a new dissociation between perception of femininity and masculinity and a huge individual difference in gender perception.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1603

Active sampling of the optic flow to predict time-to-contact

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Borja Aguado Ramirez[1,2] (borja.aguado@ub.edu), Joan López-Moliner[1,2]; [1]Vision and Control of Action (VISCA) Group, Department of Cognition, Development and Psychology of Education, Universitat de Barcelona, [2]Institut de Neurociències, Universitat de Barcelona

How we are able to estimate time-to-contact (TTC) in a 3D parabolic trajectory based on sparse depth reliable visual cues is still a challenging research issue. So far, the ecologic approach has been predominant relying on Tau and other optical variables to estimate TTC. However, Tau cannot account for the estimation of time-to-contact in different conditions such as: high lifted balls, accelerated objects or trajectories in a non collision course with the observer. We created a model that can accurately predict TTC in these situations, making use of contextual information such as: known size, gravitational acceleration and estimates of rate of the elevation angle mainly. In fact, the model predicts different outcomes depending on the portion of parabola that is visible. The aim of this study was to test the correspondence of our model's predictions with observers' estimates. To do so, we designed a task in which participants, wearing a HMD (HTC @90Hz/eye), had to time the moment a ball in a parabolic path (3 or 3.5 s flight time) returned at eye-level with a button press. We used five trajectories for which the model made accurate predictions at different times of the flight. The ball was visible during the first 300 ms. after launch. After the target was launched, participants had to look at an arrow on the floor that would indicate which commander they would use to perform the temporal judgment. While looking at the floor, they were free to choose when to look for the flying ball. As soon as they looked up, the ball was visible for another period of 400 ms. The results indicate that our model can accurately predict the observer's temporal estimates mainly based on a measure of the vertical speed within both visibility windows with the second one depending on participants' action.

Acknowledgements: First author is supported by the fellowship FPU17/01248 from Ministerio de Educación y Formación Profesional of the Spanish government. The research group was funded by the Catalan government (2017SGR-48) and grant ref. PSI2017-83493-R (AEI/FEDER,UE).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

Hello!

First, I hope you're safe.

Second, if you haven't been able to see the video presentation of my poster on the VSS website, find a youtube version here: https://youtu.be/pEzCJW7oMxU

Finally, I hope you were interested. If you have any doubt, suggestion or concern do not hesitate to tell me about it in the Zoom session.

Abstract ID: 795

Animacy perception inferred by eye movement patterns

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Sung-en Chien[1] (chiensungen@gmail.com), Su-Ling Yeh[1,2]; [1]National Taiwan University, [2]Stanford University

Visual motion contributes to high-level percepts such as animacy perception, such as that a target dot is perceived as animate when it moves along a random trajectory. It has been shown that perceived animacy of a target was weakened when task-irrelevant surrounding dots exhibited synchronous motion with the target. We examined the underlying mechanism of the modulating effect of synchronous motion by analyzing eye movements with a hidden Markov model (HMM) based approach that summarized both participant's regions of interests and scan paths. Participants were asked to rate the perceived animacy of a moving red target dot among other white dots that either had synchronous motion with the target or not. Results showed that the perceived animacy of the target was impaired by synchronous motion, consistent with previous studies. Furthermore, by clustering participants' HMMs, we showed that participants' eye fixations were initially on the target and then shifted to the surrounding dots during the task. However, participants were more likely to shift eye fixations back to the target when the surrounding dots exhibited synchronous motion as compared to when the surrounding dots did not exhibit synchronous motion. Taken together, our results showed that synchronous motion impaired the perceived animacy by inducing involuntary shifts of eye fixations back to the target. Higher perceived animacy can be inferred without subjective reports by viewing the spatial-temporal eye-movement patterns and seeing that observers are more inclined to explore the interaction between the target and the surrounding dots due to the random motion trajectory.

Acknowledgements: This research was supported by Grants from Taiwan's Ministry of Science and Technology to SY (MOST 108-2420-H-492-001-MY3) and SC (108-2811-H-002 -533)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 941

Deep Convolutional Neural Networks for Predicting Head Pose During Brain MRI Acquisition

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Yijun Zhao[1] (yzhao11@fordham.edu), Hui Yuan[1], Jingjie Zhou[1], Samantha Martin[2], Heath Pardoe[2];
[1]Fordham University, [2]NYU Langone School of Medicine

In-scanner head motion is a major source of error for brain MRI. There are currently no widely available methods for directly assessing in-scanner motion during the acquisition of neuroanatomical sequences. In this study, we developed a convolutional neural network-based method to measure changes in head pose over the duration of a scan via analysis of video obtained from an in-scanner eye tracker. Our method will allow for direct measurement of head motion during scanning, which can then be used to statistically control for head motion in quantitative neuroanatomy studies. Video data was obtained at a sampling rate of 30Hz. Thirteen healthy adults were imaged on a Siemens Prisma MRI scanner with an in-bore eye-tracker system. Ground truth head pose estimates were obtained using fMRI acquisitions that were acquired simultaneously with in-scanner video using a repetition time=1.3s (total scan time=7min). Participants carried out a series of deliberate head motions during the acquisition. Head pose over the duration of the scan was parameterized by coregistering each image volume to the first volume of the fMRI scan using rigid body registration. We employed deep learning methodologies to build 1) a classification model that classifies each video frame as “motion” vs. “no-motion” in reference to the starting position, and 2) a regression model that predicts the magnitude of subject motion for each frame. Our model is a deep convolutional neural network with nine convolutional layers, four max-pooling layers, and seven dense layers. Our classification model achieved an overall accuracy of 89% with 96% and 84% performance for the “no-motion" and “motion" frames respectively. Our regression model obtained an overall generalization loss (MSE)<7.8E-3. Sample performance plots are provided in the Supplementary Material page. Our study provides convincing data supporting the utility in-scanner video and deep learning methodologies for detecting subject motion during MRI scans.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 817

Faster switch rates in psychosis for bi-stable perception during a structure-from-motion task

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Kyle W. Killebrew[1] (kkillebr@umn.edu), Hannah R. Moser[1], Scott R. Sponheim[2,1], Michael-Paul Schallmo[1];
[1]University of Minnesota, [2]Minneapolis VA Medical Center

Bi-stable perception occurs when the same physical stimulus evokes two alternating dominant percepts. Bi-stability has been proposed to result from competition (e.g., mutual inhibition) between the two neural populations representing the distinct percepts. Prominent theories suggest that abnormal visual perception (e.g., hallucinations) among patients with psychosis may result from impaired inhibitory processes in early visual cortex. We hypothesized that these patients would perceive alternations between the two dominant percepts of a bi-stable stimulus at a faster rate than controls. We examined bi-stable perception using a structure-from-motion task in 41 patients with psychosis (e.g., schizophrenia or bipolar disorder), 25 unaffected biological relatives, and 33 healthy controls. Specifically, we presented a rotating cylinder illusion and asked participants to respond whenever they saw a change in the direction of rotation. The patient and relative groups showed faster switch rates during this bi-stable illusion compared to healthy controls. Additionally, there were no differences in switch rates between the groups in a second version of the task, in which overt depth information was added and physical direction switches were present. Excluding 17 subjects based on performance in this second task did not alter our pattern of results. Using a computational model, based on one proposed for binocular rivalry by Said and Heeger (2013), we also demonstrated results that closely matched performance for patients and controls. Our results appear consistent with a reduction in suppressive neural processes (e.g., mutual inhibition or adaptation) during motion perception among people with psychosis. Faster switch rates among relatives of people with psychosis may suggest a role for genetic liability in resolving ambiguous visual percepts.

Acknowledgements: U01 MH108150

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 392

Form and Motion in Biological Motion Perception: An Event-related Potential Paradigm

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Shan Zhang[1], Ayse P. Saygin[1]; [1]University of California, San Diego

Point-light biological motion (PL-BM) is a complex stimulus that comprises interrelated form and motion cues. Despite the inherently dynamic nature of PL-BM, much remains to be understood about the temporal

aspects of BM perception. The event-related potential (ERP) technique provides excellent temporal resolution, but typically involves time-locking to overall stimulus onset, which can make it challenging to explore subtler and ongoing aspects of processing, especially for dynamic stimuli. Here, we developed a novel variant of the ERP method, which features applying sparse visual events onto continuously presented, dynamic PL-BM stimuli. Subjects viewed PL-BM stimuli depicting locomotion with black dots corresponding to the joints of a moving body. A brief contrast reversal (i.e., change to white dots) is then applied to individual frames of the stimulus at an average rate of 3/s, with the goal of inducing a feed-forward wave of visual processing without disturbing the continuity of the ongoing motion. Each trial featured either an intact or a spatially scrambled PL-BM animation matched for local motion and motion energy. Evoked responses to the contrast-reversals showed the expected visual ERP componentry and distribution, indicating the feasibility of the approach. Furthermore, the occipital P1 (90-110ms) and parietooccipital N1 (150-170ms) components were enhanced for intact vs. scrambled PLWs. Frame-level analyses showed that while the response to the stimulus onset could dominate evoked potentials to dynamic stimuli, our ERP paradigm provides a promising approach to study the temporal aspects of BM processing by acting as a probe to “catch the visual system in action.” Follow-up experiments using this paradigm will aim to inform how form and motion cues are processed and integrated during biological motion perception.

Acknowledgements: Funded by National Science Foundation (NSF): NSF CAREER BCS-1151805

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for stopping by. Any suggestions and questions are welcome. You can reach me via e-mail at shz008@ucsd.edu for further discussion.

Abstract ID: 950

Incomplete Compensation for Visual Self-Motion in the Perception of Object Velocity

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Bjoern Joerges[1] (bjoern_joerges@hotmail.de), Laurence Harris[1]; [1]Center for Vision Research, York University

When observing a moving target while an observer is moving, the same retinal speeds can correspond to vastly different physical velocities. When an observer moves in the same direction as the target, the retinal speed is partially cancelled, and vice-versa. Observers must thus obtain an accurate estimate of their own velocity, and subtract it from or add it to the retinal speed elicited by the target to obtain an accurate estimate of the object velocity. When self-motion is experienced visually only, this compensation is likely to be incomplete, leading to biases in judgments of object motion during visual self-motion (Hypothesis 1). Furthermore, such added compensatory computations should decrease precision (Hypothesis 2). To test these hypotheses, we presented two motion intervals in a 3D virtual environment; one in which a target moved linearly to the left or to the right in the fronto-parallel plane, and one that consisted in a cloud of ¬smaller targets travelling in the same direction. The single target moved at one of two constant speeds (6.6 or 8m/s, 6m from the observer), while the speed of the cloud was determined by a PEST staircase. While observing the single moving target, participants were moved visually in the same direction, in the opposite direction, or remained static. Participants were then asked to judge which motion was faster. In support of Hypothesis 1, we found differences in accuracy between static, congruent and incongruent motion; target motion during congruent self-motion was judged as slower than in the static condition and vice-versa, indicating inadequate compensation for the observer's motion. Furthermore, we found that self-motion during target motion observation decreases precision compared to the static condition in support of Hypothesis 2. This has implications for everyday situations such as estimating pedestrians' behavior while driving a car.

Acknowledgements: LRH is supported by an NSERC discovery grant. BJ is supported by the Canadian Space Agency.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York

Presenter's Message

A subtitled version of the presentation is available on YouTube:
https://www.youtube.com/watch?v=cySl9CaQmhk&feature=youtu.be

Abstract ID: 1464

Motion estimation behind an occluder: dependence on speed and direction

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Jiayi Chen[1] (jiayichen2021@u.northwestern.edu), Melisa Menceloglu[2], Marcia Grabowecky[2,3], Satoru Suzuki[2,3]; [1]Department of Neurobiology, Northwestern University, [2]Department of Psychology, Northwestern University, [3]Interdepartmental Neuroscience Program, Northwestern University

Estimating moving objects' spatiotemporal trajectories behind an occluder is important for performing daily tasks. We investigated potential biases in extrapolating motion behind an occluder. On each trial, a bar appeared at the edge of the screen and moved across the screen with constant speed, going behind an occluder for the latter half of the movement. Participants (N=24) were asked to press a key when they thought the occluded bar had reached the end of the occluder. We manipulated motion direction (rightward, leftward, downward, and upward) and speed (taking 500, 750, 1000, 1500, or 2000ms to move across the screen) across trials. Participants generally underestimated the bar's speed as their responses were delayed relative to the actual time of the bar reaching the end of the occluder. The underestimation of the speed was minimal on trials following the initial practice trials with feedback (where the location of the bar was revealed at the time of the key press) and steadily grew over the 400 trials without feedback, indicating that the speed-underestimation bias is intrinsic. Interestingly, the amount of speed underestimation followed Weber's law (~20% underestimation) up to the speed corresponding to moving across the screen in 1000ms; for slower speeds the proportion of underestimation decreased to ~14% for 1500ms and ~10% for 2000ms. Because Weber's law held within the sub-second range (500, 750, and 1000ms), an intriguing possibility is that this underestimation may depend on the temporal duration during which motion is attended rather than speed. We will investigate this possibility by varying the size of the screen as the motion-attention-duration hypothesis predicts that the proportion of speed underestimation should depend only on temporal parameters. The amount of speed underestimation was also consistently larger in the upward direction than in other directions, potentially due to visual experience in gravity.

Acknowledgements: This study was supported by an NIH grant (T32 NS047987)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1581

Perceiving motion in the world during pursuit eye movements: Directional and confidence judgements favour a re-calibration model

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Raúl Luna[1], Ignacio Serrano-Pedraza[1,2], David Souto[3]; [1]Department of Experimental Psychology, Complutense University of Madrid, Madrid, 28223, Spain, [2]Institute of Neuroscience, Newcastle University, Newcastle upon Tyne, NE2 4HH, UK, [3]Neuroscience, Psychology and Behaviour, University of Leicester, Leicester, United Kingdom.

During smooth pursuit eye movements, retinal motion can be reafferent (caused by the eye movement) or represent motion in the world. An efference copy can be used to derive a reference signal, or amount of reafference to subtract from the image. However, the accuracy of this computation can be ensured through an image-based adaptive mechanism. Indeed, exposure to systematic background motion relative to the pursuit direction leads to a shift in the point of subjective stationarity (PSS). We aimed at elucidating the nature of this adaptive mechanism. A recalibration account predicts a shift in reference signal (i.e. predicted reafference), resulting in a shift of PSS, but no change in discrimination thresholds. An effect akin to motion adaptation contingent on pursuit direction would affect discrimination thresholds and the PSS. Participants performed a two-alternative forced-choice directional judgement task (left or right) as well as a confidence judgement task. Confidence in the directional judgements should be minimal at the PSS, unless responses are not driven by sensory evidence, allowing us to rule out a response bias [Gallagher, Suddendorf, & Arnold, (2019). Scientific Reports]. As shown before, exposure to background motion relative to the pursuit direction (random-dots, shown for 200 ms in the middle of the horizontal pursuit trajectory) shifted the PSS (test trials) towards the exposed motion, but only when tested on the exposed visual field and not the opposite visual field. Effect of exposure (same vs. opposite visual field) were of similar amplitude whether assessed with the PSS or the point of minimal confidence, indicating no response bias. Both judgements favour a recalibration account, whereby there is an adaptive shift in reference signal caused by the prevailing retinal motion during pursuit, as measured (at most) within a visual hemifield.

Acknowledgements: Supported by grant PGC2018-093406-B-I00 from Ministerio de Ciencia, Innovación y Universidades (Spain) to ISP

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hello everyone! Feel free to ask any questions.

You may also reach me through my e-mail: raluna01@ucm.es

Abstract ID: 675

Self-regulating neural mechanisms for self-motion estimation from optic flow

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Scott Steinmetz[1] (scott.t.steinmetz@gmail.com), Oliver Layton[2], Nathaniel Powell[1], Brett Fajen[1];
[1]Rensselaer Polytechnic Institute, [2]Colby College

Humans are capable of accurately perceiving self-motion direction in many different environments, ranging from the real world to virtual environments to minimal random-dot scenes commonly used in psychophysical experiments. Neural models of heading perception are less adaptive, typically relying on parameters tuned to accommodate a narrow range of experimental conditions. In the present study, we build upon the competitive dynamics model of primate brain areas MT and MST (Layton & Fajen, 2016) so that it generates robust heading estimates from optic flow in a broad range of scenes, while automatically regulating key parameters that previously needed to be set by hand. In model area MT, speed-cell tuning curves needed to be manually configured to properly encode the range of optic flow speeds, which can vary widely with changes in environmental structure, self-motion speed, and eyeheight. We adapted the principles of efficient sensory encoding (Simoncelli & Ganguli, 2014) with a temporal component that allows speed cells to dynamically adjust to the distribution of optic flow speeds recently detected by the observer. Manual parameter selection was also required in model area MSTd to properly modulate competition between cells, which balances the stability of heading perception against responsiveness to true changes in heading. One way the visual system could achieve such flexibility across environments is via neural mechanisms that self-regulate the feedback and competition in MSTd. We implemented such a mechanism, using a weighted combination of template cell activities with differing decay rates and competitive dynamics to regulate the recurrent signal. Through model simulations using video from real-world and virtual scenes, we demonstrate how these changes enable flexible adaptation across a range of environments with accuracy similar to that achieved with manually selected parameters.

Acknowledgements: ONR N000141812283

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

You can find a youtube playlist of all videos in the poster walkthrough with more detailed descriptions here:

https://www.youtube.com/playlist?list=PLhTNB4zwGYlw-vDwiKRscRXLAR4ytWd7a

Please ask any questions here using the VSS system, email me at Scott.T.Steinmetz@gmail.com, or I am on Twitter: @MathAsAnalogy

I will be scheduling a meeting time via Zoom for those interested in a live discussion of the poster, or can do face to face discussion by any app / phone if contacted via email.

Abstract ID: 1212

The Effect of Training on Vertical Heading Discrimination in a Simulated Environment

Poster Presentation - *Topic area: Motion: Biological motion, flow, eye movements*

Jong-Jin Kim[1] (johnk84@yorku.ca), Molly Gibson[1], Meaghan McManus[1], Laurence Harris[1]; [1]Center for Vision Research, York University

INTRODUCTION: People are less accurate at judging their vertical heading (2.5-3° error, ascending or descending), compared to horizontal heading (~1° error, left or right). Although vertical heading judgement is not so important in everyday life, it is very important for pilots when judging a landing approach. Here we address the impact of training on vertical heading judgement using a visually simulated landing task. METHODS: Untrained participants (15 males and 23 females; mean age = 20.1) performed vertical heading judgements in a virtual environment with a clearly defined ground plane and horizon. For three target angles (3°, 6° and 9°), they judged they would land before or after a target after a visually simulated descent of two seconds. After this test, half of the participants completed a flight simulator landing training task which provided feedback on their vertical heading performance (training group), while the other half completed a two-dimensional puzzle game (control group). The participants repeated then the vertical heading judgement test. Negative values indicate too shallow of an approach and consequently overshooting the target. RESULTS: Overall, participants overestimated their angle of descent, overshooting the target in their vertical heading judgements as consequence. The training group showed improvement in their accuracy in the second testing where the average error was significantly reduced after the landing training (from -1.92±.24° to -0.62±.22°, $p < .001$), while the control group did not (from -1.7±.44° to -1.3±35°, $p = .187$). CONCLUSION: Our results suggest that with training using a flight simulator landing for variety of target angles, vertical heading judgments can become as accurate as horizontal heading judgments. This study is the first to show the effectiveness of training in vertical heading judgement in naïve individuals. The results are applicable in the field of aviation, informing possible strategies for pilot training.

Acknowledgements: LRH is supported by Discovery Grant from the Natural Sciences and Engineering Research Council (NSERC) of Canada and the Canadian Space Agency. JJK holds doctorate scholarship from VISTA program.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 888

Motion: Global motion, optic flow

Access to sensory uncertainty in global motion perception depends on the stimulus

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Marshall L. Green[1] (mg2057@msstate.edu), Michael S. Pratte[1]; [1]Mississippi State University

Global motion perception is studied by showing moving dots, but the way that these dots are generated varies substantially across studies. We have recently shown that when the direction of each dot is generated from a Gaussian distribution, global direction perception is achieved by averaging local motion signals, as is assumed in standard models of motion perception. However, with a more typical stimulus in which dots moving in the same direction (signal) are intermixed with randomly moving dots (noise), participants actively segregate signal from noise, and then identify the global direction based on signal dots alone. This finding raises a critical question: If you can pull apart signal from noise under some stimulus conditions but not others, does your ability to monitor internal sensory uncertainty in motion representations also depend on whether or not signal and noise can be segregated? We measured conscious access to sensory uncertainty by having participants rate their confidence in the accuracy of motion direction judgments. The motion stimuli were manipulated across various levels of difficulty and stimulus type. For stimuli in which direction identification relied on averaging local motion, confidence tracked with a measure of local averaging accuracy. However, for stimuli in which signal and noise could be segregated, confidence tracked with a measure of whether or not segregation was successful, but had no relationship with measures of local averaging. Taken together, these results show that global motion perception relies on different mechanisms depending on the stimulus type. Moreover, conscious access to uncertainty in the underlying representations likewise depends on stimulus type. Therefore, the details of how stimuli are constructed can drastically alter not only how global motion is processed, but also the nature of our conscious access to these processes.

Acknowledgements: This work was funded by NIH award R15MH113075.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1513

Behaviorally dependent properties of retinal motion during natural locomotion

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Karl Muller[1] (karl.muller@utexas.edu), Kate Bonnen[2], Jonathan Matthis[3], Alexander Huk[1], Mary Hayhoe[1]; [1]University of Texas at Austin, [2]New York University, [3]Northeastern University

Patterns of motion on the retina during locomotion depend critically on both eye and body motion, and these in turn depend on behavioral goals. In rocky terrain, walkers look close to the body to locate stable footholds, whereas in smooth terrain, gaze is mostly on more distant regions (Matthis et al, Current Biology 2018). In order to describe the statistics of retinal motion over a range of different eye movement patterns, we recorded eye and body movements during natural locomotion, together with video from a head-mounted camera, using a Pupil Labs mobile eye tracker integrated with an IMU-based motion capture suit. Eye movement data were analyzed to extract the fixations and then aligned relative to gaze location. Using video-based optic flow estimation of the retinally-aligned images, we derived retinal motion patterns during locomotion over a variety of terrains, during the periods of stable gaze. Analysis of retinal motion inputs expressed as the magnitude of expansive and rotational motion at each retinal location reveals complex spatial structure that depends both on the lateral angle of gaze relative to translation direction, and also the gaze angle relative to gravity. More eccentric gaze relative to body translation direction affects the rotational components of motion, with little effect on the expansive components, which varies primarily as a function of distance from the subject. Conversely, gaze angle relative to gravity affects primarily the expansion component with little effect on the rotational components. At downward gaze angles, there is greater expansion in the upper visual field compared to lower. At gaze angles closer to the horizon there is greater expansion in the lower visual field. Since gaze varies systematically with gait patterns and terrain complexity, this allows the selection of behaviorally-relevant representative motion stimuli for both physiological and psychophysical experiments.

Acknowledgements: Supported by Grants R01 EY05729, 5T32LM012414-04, K99 EY028229

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please email karl.muller@utexas.edu for any questions/comments

Thank you!

Abstract ID: 799

Frame-induced position shifts

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Patrick Cavanagh[1] (patcav1@yorku.ca), Mark Wexler[2], Stuart Anstis[3]; [1]Glendon College / Dartmouth College, [2]CNRS / Universite de Paris, [3]UCSD

Moving frames strongly affect dot organization (Johansson) and motion direction (the Duncker illusion). In both cases, the direction of motion is altered. Here we report that a moving frame also shifts the perceived positions of dots flashed within it. Specifically, when participants are asked to judge the absolute locations of flashed dots, they tend to report the relative dot locations within the frame, as if the frame were almost stationary. For example, while a frame is moving up and down vertically, one dot is flashed near the upper edge of the frame when it is at its lowest end of travel and a second dot flashed near the bottom edge of the frame at the upper end of the travel. Even though these two dots are physically located at the same position they appear separated by almost 70% of the frame's travel. These effects are also seen with a moving "frame" consisting of just one or two dots. These frame-induced position effects suggest a link to visual constancy where we see a steady world despite massive displacements during saccades. In this case, object locations are experienced relative to their positions in the overall scene, ignoring its motion, rather than to their ever-changing retinal locations within the visual field.

Acknowledgements: NSERC Canada (PC), Dartmouth PBS (PC), UCSD (SA)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 1:00 am EDT America/New_York

Presenter's Message

OOPS, I put 1 am EDT for the presentations but I meant 1 pm. Zoom meetings are 1 pm Saturday and Monday. Sorry to those of you who show up at 1 am.

Abstract ID: 607

Look where you go: Humans intuitively track heading direction changes with their eyes

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Hiu Mei Chow[1] (dorischm@gmail.com), Jonas Knöll[2], Matthew Madsen[1], Miriam Spering[1]; [1]University of British Columbia, Vancouver, Canada, [2]Institute of Animal Welfare and Animal Husbandry, Friedrich-Loeffler-Institut, Greifswald, Germany

Successful performance of daily activities such as driving a car relies on the accurate perception of self-motion, such as the direction and speed of heading. Small groups of primates—humans, macaques, marmosets—can track heading direction with their eyes in the absence of any instruction and with only minimal training (Knöll et al. PNAS 2018). Here we investigated if this tracking behavior is generalizable to a larger group of human observers and sensitive to changes in motion signal strength. Observers (n=43) viewed a cloud of moving dots that appeared to converge to one point, resulting in perceived self-motion towards or receding from the focus of expansion (FOE). FOE location shifted across time in a random walk fashion. Observers were asked to freely view the stimulus; eye position was recorded using an Eyelink 1000 eye tracker. In Exp.1 (n=19), we verified if observers could track suprathreshold stimuli (coherence: 100%; contrast: 33%; speed: 2m/s). In Exp.2 (n=24), we tested the effect of motion signal strength by manipulating coherence (6.25-100%), contrast (3.6-90%), and speed (0.75-6m/s). Results show that observers intuitively track heading direction changes using a combination of saccades, fixation, and slow drift. In both experiments, more than 80% of observers tracked the FOE with highly correlated position trajectories (cross-correlation coefficient > 0.6) in response to high signal-strength stimuli. Spatial tracking error (eye position error between eye and FOE) increased with motion signal strength decreasing from the highest to the lowest level of coherence (32% error increase), dot contrast (24% error increase), and speed (44% error increase). Intuitive ocular tracking of heading direction is generalizable to a larger group of human observers, and is finely tuned to low-level motion signals. Future work will explore whether we can utilize eye movements as an indicator of self-motion perception in clinical populations

Acknowledgements: This work was supported by Wall Solutions Grant funded by the UBC Peter Wall Institute of Advanced Studies and Research Trainee Award funded by the Michael Smith Foundation for Health Research.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Welcome to my poster!
Let me know if you have any questions. I am happy to chat generally about vision, audio-visual perception, or how we can create a more inclusive community within vision science. Please feel free to connect via email (dorischm at gmail.com) or Twitter (handle: @_DorisChow).

Abstract ID: 443

Motion Silencing is Caused by the Interpretation of Structure from Motion

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Qihan Wu[1] (qwu30@jhu.edu), Juan Suárez Burgos[1], Jonathan Flombaum[1]; [1]Johns Hopkins University

Motion silencing (Suchow & Alvarez, 2005) is a striking illusion. Participants easily perceive color changes in an array of 100 dots. But if the array of dots rotates around a circle, the perception of change becomes difficult, 'silenced'. The predominant suggestion has been that it reveals a failure of change detection, perhaps owing to a limitation of small receptive fields. Some illusions indeed reflect properties of visual 'wetware'. But often illusions reveal an interpretive mistake in the visual system, a wrong decision about what is there given the input. We suggest that the interpretation of structure from motion produces silencing. Note that motion around a circle —the standard stimulus— can be interpreted as a case of structure: a rotating surface. To test our theory, we sought a stimulus in which we could untangle motion and the implication of structure. We, therefore, turned to the classic structure-from-motion rotating cylinder. By overlaying two groups of oppositely translating dots, participants perceive a 3D rotating cylinder. We produced such a stimulus in which the dots changed color. When the dots were static, changes were easily noticed. But when the dots moved —producing the cylinder percept— silencing was observed (as measured by asking participants to report which stimulus had color changes at a faster rate). Critically, when the two sets of dots translated in the same direction, removing the cylinder percept, no silencing was reported. (i.e. Participants chose this stimulus and the static stimulus as changing faster, equally often). If silencing reflects a limitation of change detection, the limitation should be equally present when the dots translate in the same or opposite directions. But it was only present when the total motion implied underlying structure, revealing that silencing is an interpretation not a limitation of perception.

Acknowledgements: NSF PAC #153468

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

22 June, 11:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1400

Motion perception is biased toward the orientation, not the direction, of the preceding motion

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Jongmin Moon[1] (jmoon@unist.ac.kr), Oh-Sang Kwon[1]; [1]Department of Human Factors Engineering, Ulsan National Institute of Science and Technology

Numerous studies have shown that perception of the current stimulus is affected by the preceding stimuli. This sequential effect was shown with various visual features, including orientation of Gabor and direction of pointing arrow. In motion direction estimation, the feature responsible for the sequential effect is ambiguous. The direction, which is the task-relevant feature, or the orientation, a feature that is implicitly activated, can determine the effect. Here we examined whether the sequential effect in motion perception is determined by the direction or the orientation of the preceding motion. Subjects were asked to report the perceived direction of a random-dot motion stimulus (coherence: 40%, duration: 500 ms, direction: randomly chosen from 0-360°). In line with past studies, subjects' responses were systematically attracted to the motion direction on the previous trial when the current motion direction was in the vicinity of the previous motion direction. Interestingly, when the current motion direction was instead in the vicinity of the opposite direction of the previous motion direction, the responses were biased toward the opposite direction of the previous motion direction. The magnitudes of biases toward the two different directions were comparable. Furthermore, response error on the current trial was positively correlated with response error on the previous trial when the previous and current motion directions were similar, and they were also positively correlated when the previous and current motion directions were opposite to each other. To rule out possible contributions of motion streaks in random-dot motion, we ran a control experiment using a streak-free, moving texture stimulus generated by bandpass filtering random noise in the spatiotemporal frequency domain. The results showed consistent sequential effects of motion orientation. Our findings show that the sequential effects in motion perception mostly occur based on the orientation of the preceding motion, rather than the direction of it.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1762

Object motion and flow variance across optical contexts

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Jan Jaap R. van Assen[1], Takahiro Kawabe[1], Shin'ya Nishida[1,2]; [1]NTT Communication Science Laboratories, [2]Graduate School of Informatics, Kyoto University

One main goal of visual motion computation is to estimate the trajectory of objects moving in the scene from retinal optical flow. This is a tough computational problem under real-world conditions because retinal optical flow drastically changes with the optical material properties of the moving object. Specular and diffuse reflections, as well as refractions at object surfaces can produce complex patterns of optical flow that do not correspond with the object motions. In addition, these complex flow patterns vary with object shape and surrounding illumination. In this study we are investigating how constant we are in perceiving object motion across various contexts and if we compensate for other causal sources in motion. To see how much perceived object motion is independent of, or dependent on these factors, we asked twelve naïve observers to compare the rotational speed of two objects (T: test and M: match). M has matte shading with a texture, “knot” shape, and “forest” illumination map, while T was chosen from combinations of ten optical properties (e.g., matte, glossy, translucent), three shapes (knot, cubic, blobby), and three illumination maps (sunny, cloudy, indoor). The object rotation was around the vertical axis of the object at 0.5 rotation/sec for T, and variable for M. The exposure of each object was 500ms, and the PSE was estimated by a 2-IFC staircase method. We find illusory differences in perceived rotational speeds for different material, illumination, and shape conditions (e.g., transparent materials appear to rotate faster). Low-level optical flow models using horizontal optical flow and optical flow gradients explain 56% of the variance of the perceived speeds, but the magnitude of misperception predicted by the optic flow is much larger than the observed effect. These results suggest that the human visual system only partially compensates for effects of optical contexts in object motion.

Acknowledgements: Japan Society for the Promotion of Science (JSPS KAKENHI Grant Number JP15H05915)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 2:00 am EDT America/New_York
22 June, 8:00 am EDT America/New_York

Presenter's Message

If you have any questions about this study or my other work please don't hesitate to email me at mail [at] janjaap [dot] info. We can schedule video meetings as well.

Abstract ID: 458

Static noise can improve motion sensitivity

Poster Presentation - *Topic area: Motion: Global motion, optic flow*

Remy Allard[1] (remy.allard@umontreal.ca); [1]Universite de Montreal

Although early filters are narrowly tuned in the spatial frequency domain, distant spatial frequencies are not completely independent as cross-frequency interactions can facilitate (improve) or impair contrast sensitivity. For instance, a high-spatial frequency texture at high contrast can impair contrast sensitivity to low spatial frequencies, whereas at low contrast, it can facilitate contrast sensitivity. This surprising facilitation could be caused by late interactions within the visual system (e.g., integration of outputs from simple cells tuned to different spatial frequencies) or early interactions (e.g., cross-frequency lateral inhibition in the LGN). The current study investigated whether the cross-frequency interaction responsible of the facilitation effect occurs at a late stage where form and motion processing are distinct or at an earlier stage before form and motion processing have distinct pathways. If the cross-frequency interaction occurs at a stage at which form and motion processing are distinct, then static noise should have no impact on motion sensitivity. On the other hand, if the cross-frequency interaction occurs at a stage at which form and motion are not distinct, then static noise should have the same impact on contrast and motion sensitivity. We investigated the impact of static band-pass noise (2 to 8 cpd) on motion sensitivity of a 0.5-cpd Gabor drifting at temporal frequencies from 0.9375 to 15 Hz. The noise was full-screen and continuously displayed to avoid being spatial or temporally informative. The contrast of the noise was set to optimize the facilitation on contrast sensitivity based on a pilot study. Static noise was found to facilitate motion sensitivity at all temporal frequencies with a similar amplitude as observed for contrast sensitivity. The fact that static noise at high spatial frequencies can improve motion sensitivity suggests that the facilitation is caused by cross-frequency interactions occurring before form and motion are processed by distinct pathways.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1636

Motion: Models and mechanisms

A large white matter bundle connecting area prostriata and visual thalamus in humans

Poster Presentation - *Topic area: Motion: Models and mechanisms*

Jan W. Kurzawski[1,2] (jan.kurzawski@gmail.com), Kyriaki Mikellidou[3], Maria Concetta Morrone[2,4], Franco Pestilli[1]; [1]Indiana University Bloomington, [2]IRCCS Stella Maris, [3]University of Cyprus, [4]University of Pisa

Area prostriata preferentially responds to very fast motion, greater than 500 deg/sec, and has a complete representation of the visual field, similarly to all known visual areas, however it does not follow the traditional cortical magnification rule. Instead, it has a strong preference for peripheral and wide-field stimulation. A full-map of the structural connections of prostriata is currently unreported in the human brain. We investigated the connectivity between area prostriata and the visual thalamus, specifically the lateral geniculate nucleus (LGNs). We combined four data modalities (T1- and T2-weighted anatomical images, functional population receptive field (pRF) mapping and ensemble tractography) together with statistical evaluation methods on data from the Human Connectome Project (HCP). Structural and functional data were integrated to characterize the corticothalamic connections of area prostriata. We observe a continuous and structurally complex bundle of white matter fibers which were arbitrarily subdivided into two sub-components: one passing ventrally parallel to the optic radiations (OR) and another circumventing the lateral ventricle. Interestingly, whereas the loop travelling more superiorly transfers information between the LGN and prostriata directed to the central visual field, the other sub-tract travelling inferiorly along the OR transfers information from the peripheral visual field. This result is consistent with a retinotopic segregation also demonstrated in the OR which connects the LGN and V1 in humans. Our results demonstrate for the first time such a segregation in a fiber bundle connecting the thalamus with an associative visual area.

Acknowledgements: NSF IIS-1636893, NSF BCS-1734853, NIH NIMH ULTTR001108, NIH NIMH U01MH097435, NIH NIMH 5 T32 MH103213, a Microsoft Research Award, a Google Cloud Award, the Indiana University Areas of Emergent Research initiative “Learning: Brains, Machines, Children”, and Pervasive Technology Institute to F.P.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1233

Geometric model of the determinants of retinal flow during natural viewing

Poster Presentation - *Topic area: Motion: Models and mechanisms*

Paul MacNeilage[1] (pmacneilage@unr.edu), Christian Sinnott[1], Peter Hausamann[2]; [1]University of Nevada, Reno, [2]Technical University of Munich

Visual motion at the retina is driven predominantly by movement of the eye relative to the stationary environment and depends on the distance from the eye to the nearest environmental surface. To better understand how retinal motion depends on eye motion and scene structure, we developed a geometric model. Movement of the eye in space is modeled as the sum of head-in-space and eye-in-head motion. As input, the model takes information about 3DOF linear and angular head velocity, 2DOF head orientation relative to gravity, and 2DOF eye-in-head position. The model makes two important assumptions: 1) compensatory eye movements (i.e. the vestibulo-ocular reflex) work to cancel head-generated flow at the fovea, and 2) the environment consists of an earth-horizontal ground plane such that distance from the eye to the nearest surface is completely specified by eye height, head orientation relative to gravity, and eye-in-head position. To generate predictions using the model, human subjects walked around campus as we recorded head velocity in space and head orientation relative to gravity using an Intel RealSense tracking camera (t265), as well as eye-in-head position using a Pupil Labs Core binocular eye tracker. The model predicts that retinal flow is driven strongly by linear head velocity with faster motion in the lower visual field, due to the orientation of the eye relative to the ground plane, and toward the retinal periphery, due to the effect of stabilizing eye movements. We compare these predictions with an approximate reconstruction of retinal flow based on a sub-sampling of the eye tracker world video centered on the gaze point, and we discuss factors responsible for deviation of the model prediction from this reconstruction.

Acknowledgements: Research was supported by NIGMS of NIH under grant number P20 GM103650 and by NSF under grant number OIA-1920896.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1492

Reconstruction of motion direction from fMRI data

Poster Presentation - *Topic area: Motion: Models and mechanisms*

Riccardo Barbieri[1] (rbrb914@gmail.com), Felix M. Töpfer[1], Joram Soch[1], Carsten Bogler[1,2], John-Dylan Haynes[1,2,3]; [1]Charite - Berlin, Bernstein Center for Computational Neuroscience, [2]Humboldt-University of Berlin, [3]Technical University Dresden

The neural representation of visual motion perception has been extensively studied in cognitive and visual neuroscience. Functional magnetic resonance imaging (fMRI) is often used in combination with multivariate pattern analysis to identify brain areas associated with motion perception (Kamitani&Tong, 2006). The assumption is that certain voxels are sensitive to motion direction, and the resulting activity pattern can be exploited to discriminate between alternative motion directions from new data. An alternative approach consists in specifying a forward model describing the mapping between changes in motion direction and the expected voxel activity with a basis set. The model estimates can be inverted and used to perform stimulus reconstruction (Inverted Encoding Models; Brower&Heeger, 2009). Encoding models typically seek the ideal response profile of motion-selective neuronal populations tuned to different directions. The choice of basis functions is often difficult, as cells tuned to motion direction can exhibit various of response profiles (Albright, 1984). Here we tested a novel nonparametric approach to motion direction reconstruction. The method is based on a cyclic version of Gaussian Process Regression (GPR – Rasmussen & Williams 2006) to obtain a continuous estimate of direction-dependent voxel responses. 24 participants performed a feature-continuous perceptual decision-making task during an fMRI experiment. In each trial, they viewed a 2s motion dot stimulus with different coherence (0%, 100% and a medium level) and direction (randomly varying from 0° to 360°), and indicated the perceived motion direction. For each subject, we estimated the trial-wise activity of individual voxels during the stimulus period. Using GPR, we obtained a continuous response profile for each individual voxel. The estimated voxels response profiles within a searchlight were then combined to obtain a trial-wise predicted direction. We found that the motion direction could be reconstructed from early visual cortex, and that the reconstruction was less precise with decreasing motion coherence.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1274

The “twinkle goes” illusion: Attention-dependent extrapolation of motion

Poster Presentation - *Topic area: Motion: Models and mechanisms*

Ryohei Nakayama[1,2], Alex O. Holcombe[2]; [1]National Institute of Information and Communications Technology, [2]The University of Sydney

Although previous work shows that the location of the sudden disappearance of a moving object is typically perceived correctly, we find that on a dynamic noise background, using an alignment judgment task, the disappearance location is shifted in the direction of motion. This “twinkle goes” illusion requires the background to be dynamic noise immediately after the disappearance, but has little dependence on the luminance contrast of the moving object. In an experiment with nine observers, the magnitude of the perceptual shift increased linearly with object speed (2-36 deg/sec) with a slope that implies 56 ms (SE = 9) of extrapolation. An additional experiment revealed that when observers’ attention was divided between two moving objects, one of which was cued for judgment after the disappearance, the shift was eliminated. We propose that attentional tracking has an “inertia” which extends the perceived trajectory of a moving object unless it is captured by a luminance transient associated with an abrupt disappearance. The tracking inertia theory also predicts that on a dynamic noise background, the perceived location of the reversal of a moving object will not be shifted in the direction of initial motion. We will test this prediction.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1020

The role of stimulus features and response method on feature-continuous motion perception

Poster Presentation - *Topic area: Motion: Models and mechanisms*

Felix M. Töpfer[1] (felix.toepfer@bccn-berlin.de), Riccardo Barbieri[1], Joram Soch[1], Carsten Bogler[1,2], John-Dylan Haynes[1,2,3]; [1]Charite; Berlin; Bernstein Center for Computational Neuroscience, [2]Humboldt-University of Berlin, [3]Technical University Dresden

Motion perception is an important function of the human visual system (e.g. Braddick 1974). Experiments on motion have typically employed categorical tasks, where subjects had to either detect the presence of motion (Van Doorn & Koenderink 1982) or decide whether motion was going in one out of a few discrete directions (Newsome & Paré 1988). Only very recently focus has shifted towards continuous report tasks (Luck VSS2018, Barbieri VSS2018) as they reflect the natural inherent continuity of low-level sensory features and might allow a more precise identification of the underlying perceptual processes (Smith 2016). Here we describe a perceptual decision-making experiment in which six groups of participants were tested on combinations of different stimuli and response modalities. In a two-by-three factorial design, we assessed behavioral performance of three types of feature-continuous RDKs: Brownian Motion (BM), Transparent Motion (TM) and Limited Lifetime White Noise Motion (WM), judged by using two alternative response methods. The first consisted of a 'direct' response, which required participants to move a trackball in the desired direction. The other, was an 'indirect' response, in which a single button had to be pressed when a self-rotating line matched with the chosen direction. By using a five parameter von Mises Mixture Model (vMMM), we were able to evaluate the properties of accumulated distributions of trial-wise response deviations, including detection, guessing, systematic errors, and a specific type of mis-perception (reporting the opposite direction) that would go unnoticed in standard categorical task designs. We further show that the detection frequencies are largely independent of stimulus and response modalities, while the precision parameters are more sensitive to both factors. Taken together, our findings underline the benefits and caveats of feature-continuous task designs, and validate the use of a diagnostic tool that allows to estimate the underlying parameters of the response distributions.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 491

Multisensory Processing: Visuo-auditory interactions

Are perceptual metamers causal metamers? A study of multisensory integration and metacognitive access in cue combination

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

Callie Mims[1] (callie.mims@ufl.edu), Nicholas Rosario[1], Anya Preston[1], Kendra Westmoreland[1], Kiara Lolo[1], Brian Odegaard[1]; [1]University of Florida

Perceptual metamers occur when identical estimates are formed for physically distinct sensory signals. Multisensory integration represents one example of this phenomenon, as small misalignments in temporal or spatial properties of audiovisual stimuli may result in the same perceptual report as judgments for fully congruent audiovisual stimuli (DeRoy, Spence, Noppeney, TICS, 2016). This scenario raises two intriguing questions about perceptual metacognition for multisensory metamers: (1) are confidence judgments for metameric stimuli similar, or different? (2) Can subjects discriminate between conflicting and non-conflicting multisensory events, even when the perceptual report is the same? In this investigation, we investigated these questions using the sound-induced flash illusion. On each trial, observers were presented with 1-4 flashes and 1-4 beeps, and were asked to judge three things: (1) the number of flashes that were presented, (2) their confidence in the judgment about the number of flashes, (3) their confidence in whether the number of stimuli presented in each modality were the same, or different. We selected subsets of trials across conditions yielding perceptual metamers; specifically, we selected trials across pairs of conditions where the flash response was the same ("metamer trials"). Results showed that for metamer trials with smaller numbers of stimuli, participants were significantly more confident in their response about the number of flashes when audiovisual stimuli were congruent than when they were incongruent. For metamer trials with larger numbers of stimuli, confidence was similar across conditions. Interestingly, when making judgments about confidence in whether the number of beeps and flashes were the same or different on each trial, these "causal confidence" judgments did not significantly differ across any condition pairs. These results provide preliminary evidence that while some perceptual metamers may be causal metamers, metacognition for individual sensory signals may still index differences between metameric stimuli that yield the same perceptual reports.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 724

Audiovisual Recalibration and Stimulus Reliability

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

Fangfang Hong[1], Stephanie Badde[1], Michael Landy[1,2]; [1]Department of Psychology, New York university, [2]Center for Neural Science, New York university

Discrepancies between signals from the different senses allow sensory systems to detect and correct calibration errors and thus restore coherent perception of the world. However, given two conflicting cues, the brain must infer which sensory modality requires recalibration. Two types of models have been proposed: (a) Reliability-based: Each modality is recalibrated according to its relative reliability; (b) Fixed-ratio: The degree of recalibration of each modality is fixed. We tested audiovisual spatial recalibration while varying visual stimulus reliability. Visual stimuli were clusters of ten Gaussian blobs; reliability was adjusted by varying the SD of blob locations. The auditory stimulus was a broadband noise burst. We required auditory localization thresholds to fall within the range of tested visual thresholds and ensured this was so by measuring unimodal localization thresholds using a two-interval forced-choice (2IFC) procedure. Next, we measured auditory localization biases relative to visual standards (2IFC). The main recalibration experiment consisted of three phases. (1) Baseline: subjects localized single-cue auditory and visual stimuli. (2) Recalibration: subjects were presented with bimodal stimuli with a perceptually, rather than physically, fixed spatial discrepancy — based on the previously measured auditory localization biases — between the two modalities. Subjects localized one modality, cued after stimulus presentation, using a visual cursor. (3) Post-recalibration: unimodal localization performance was remeasured. In accordance with a fixed-ratio model, most subjects showed no significant visual recalibration even when visual cues were very unreliable. Surprisingly, many subjects showed increased auditory recalibration with decreasing visual reliability, which cannot be explained by either the reliability-based or the fixed-ratio models. Other subjects showed no change or decreasing auditory recalibration. However, a causal-inference model of cross-modal recalibration, in which recalibration requires an inference of the two cues deriving from a common source, captures the diverse influences of cue reliability on recalibration.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1418

Auditory and visual information affect social event segmentation differently

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

Francesca Capozzi[1], Nida Latif[1], Emma Ponath[1], Jelena Ristic[1]; [1]McGill University

Humans spontaneously parse the dynamic environmental content into social and non-social events. Although social segmentation is thought to reflect a perceptual grouping process, the role of different perceptual modalities in this ability remains unclear. Here we tested how auditory and visual social information in isolation and in conjunction influenced social segmentation. Participants viewed a video clip depicting a dyadic social interaction. In separate groups, they first viewed the clip including only auditory or visual information and then including both modalities. In each condition, participants were asked to mark social and nonsocial events in separate blocks by pressing a keyboard key. Results indicated both overlapping and unique social and nonsocial events. Replicating past data, analysis of response agreement and variability revealed that social events were recognized with higher agreement and lower variability than nonsocial events, especially when both auditory and visual information was available. The lowest agreement and the highest variability were found when participants segmented nonsocial events using auditory information only, while the highest agreement and the lowest variability were found when participants segmented social events using auditory and visual information after they have segmented the same video using visual information only. Thus, visual social information appears to have a facilitatory effect on social segmentation with auditory and visual information influencing the ability to parse the environmental socio-interactive content into social and nonsocial events differently.

Acknowledgements: Social Sciences and Humanities Research Council of Canada (SSHRC); Natural Sciences and Engineering Research Council of Canada (NSERC); William Dawson Chairs Fund

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please feel free to send me any additional question or comment at francesca.capozzi@mail.mcgill.ca

Additional information on my work can be found at https://francescacapozzi.wordpress.com/

Abstract ID: 420

Auditory spatial discrimination in chronic hemianopes

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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Stroke damage to the primary visual cortex (V1) causes blindness in the contralateral hemifield, known as hemianopia. We are interested to see if it also affects abilities beyond visual perception. The auditory and visual systems are highly interconnected, although mechanisms of multisensory perception are not well understood in the context of adult-onset, visual cortical damage. Neuroplastic changes following visual deficits may impair, enhance or have no effect on auditory spatial processing. This in turn, has implications for designing multisensory, perceptual training paradigms that are intended to recover vision in hemianopic fields. Here, we investigated the impact of adult-onset, stroke-induced V1 damage on auditory spatial discrimination in 17 hemianopes (mean±SD age 57.5±13.5 years, 22.6±18.7 months post stroke). Goldmann perimetry measured the size of the patients' residual visual field as ranging from 6,884 to 14,678 deg^2 (11,074±2,372 deg^2). Auditory performance in hemianopes was compared to that of 14 age-matched, visually-intact controls (55.2±12.0 years). While fixating straight ahead, subjects heard two, sequentially-presented sounds localized (virtually over headphones) symmetrically about a reference azimuth. They were asked whether the second sound was to the left or right of the first sound. Two reference azimuths (20° and 40°) were tested in both hemifields for a total of four conditions. Overall, separation thresholds were better for the 20° than 40° condition ($p=0.036$) but similar between hemifields ($p=0.53$) and subject groups ($p=0.38$). The differences in thresholds between blind and sighted hemifields in hemianopes were not more variable than expected from control subjects, and auditory discrimination did not correlate with the size of the visual defects. Therefore, large visual deficits from V1 damage sustained in adulthood do not appear to impact relative auditory localization. This intact auditory processing has the potential to be harnessed for new, multisensory, perceptual training strategies to help hemianopes regain vision in their blind fields.

Acknowledgements: National Eye Institute, Research to Prevent Blindness, National Institute on Deafness and Other Communication Disorders

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 557

Bounce or stream? Motion dynamics modulate the audiovisual bounce inducing effect

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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In classic audiovisual bounce inducing effect (ABE) demonstrations, the perceptual interpretation of two identical objects moving along the azimuth with uniform motion and towards opposite directions is bistable and depends on whether a sound is presented in coincidence with the point of overlap of the two objects' motion trajectories. The mechanistic basis of the ABE is poorly understood. Here, we sought to characterize the mechanisms underlying the ABE in two experiments. In Experiment 1, we tested the effects of altering visual motion dynamics on bounce vs stream perceptual interpretations by presenting observers with events where the two discs moved with uniform rectilinear motion, acceleration, or deceleration. Sound was presented in coincidence with the point of overlap of the two objects or was absent, and object motion was varied (i.e., upwards or downwards). We found that motion dynamics acted to shift perceptual interpretations such that events with downwards accelerating visual motion were more likely to be interpreted as a 'bounce' event relative to those with uniform motion and decelerating motion. Curiously, there were no differences in perceptual interpretations between the three motion dynamics when stimuli moved in the upwards direction. In Experiment 2, we presented identical stimuli (downwards only) to observers while measuring functional magnetic resonance imaging (fMRI) responses concurrently with behaviour in a 3T scanner. We found that events with accelerating- and to a lesser extent, decelerating motion, elicited stronger responses in a number of cortico-vestibular regions, including the posterior parietal cortex, premotor cortex, and the posterior insula, as compared to events containing uniform motion. Notably, responses in these regions also varied depending on perceptual interpretation (i.e., bounce vs stream). Our data suggest that the origins of the ABE extend beyond simple attentional mechanisms as commonly put forth and involves vestibular engagement.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hello! Thanks for dropping by. Please do leave messages!

Abstract ID: 953

Cross-modal suppression model of speech perception: Visual information drives suppressive interactions between visual and auditory speech in pSTG

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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Human speech consists of visual information from the talker's mouth and auditory information from the talker's voice. A key question is whether the neural computations that integrate visual and auditory speech are additive, superadditive (excitatory) or subadditive (suppressive). To answer this question, we recorded brain activity from 7 patients implanted with electrodes for the treatment of medically-intractable epilepsy. We examined 33 intracranial electrodes (iEEG) located over the posterior superior temporal gyrus (pSTG), a key brain area for multisensory speech perception. Patients listened to audiovisual speech words in three formats: natural asynchrony between auditory and visual speech onset, auditory speech onset advanced 300 ms (A300V), and visual speech onset advanced 300 ms (V300A). We used deconvolution to decompose the measured iEEG responses to audiovisual speech into unisensory auditory and visual speech responses. Manipulating the asynchrony of the auditory and visual speech allowed us to separately estimate the responses to auditory and visual speech, and hence the rule by which their neural responses were combined. The deconvolved esponses were then fit to two models. The additive model sums the deconvolved unisensory responses and was a poor fit to the actual data (RMSE=41). The non-additive model sums the deconvolved unisensory responses plus an auditory-visual interaction term. The non-additive model was a better fit to the actual data (RMSE=20). We also examined the sign of the interaction term. A positive interaction indicates a measured response greater than the summed unisensory responses (superadditivity), while a negative interaction indicates a measured response less than the summed unisensory responses (subadditivity). The interaction was negative for 25 of 33 electrodes. These data indicate a suppressive interaction between visual and auditory speech information consistent with a cross-modal suppression model of speech perception in which early arriving visual speech information inhibits the responses of neurons selective for incompatible auditory phonemes.

Acknowledgements: NIH R01NS06395, U01NS098976 and R25NS070694

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
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Presenter's Message

Please contact Michael Beauchamp at michael.beauchamp@bcm.edu for more information.
A preprint is available at https://www.biorxiv.org/content/10.1101/2020.04.16.045716v1

Abstract ID: 434

Evidence of audiovisual interactions in the primary auditory cortex

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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Multisensory processing has been suggested to occur in primary sensory regions (Murray et al., 2016). This is supported by animal studies revealing monosynpatic afferents between the visual cortex and other low-level sensory regions (Cappe & Barone, 2005), and that visual or tactile stimuli can modulate the response of neurons in the auditory cortex (Fu et al., 2004; Lakatos et al., 2007). In humans, DTI studies have revealed fiber tracts connecting the heschl gyrus and the occipital pole (Beer et al., 2013), but it remains unclear whether this connectivity represents multisensory interactions taking place in these early sensory regions. In the current study, we examined whether audiovisual multisensory interactions can be observed in the primary visual (V1) and auditory (A1) cortex in humans, by using source-imaged and frequency tagged SSVEP/AEP. Visual (2 cpd gratings) and auditory (440 Hz pure tone) stimuli were presented at an on/off modulation rate of 3.75 Hz, simultaneously (audiovisual condition) or alone (auditory-alone or visual-alone conditions). For the visual-alone condition, a signal-to-noise ratio (SNR) at 3.75 Hz (the first harmonic component, 1F) greater than 1 was observed in both A1 and V1, while for the auditory-alone condition, an SNR greater than 1 was only observed in A1. These findings suggest that while the visual stimulus elicited a response in both A1 and V1, the auditory stimulus elicited a response only in A1. For the audiovisual condition, an SNR greater than 1 was observed in both A1 and V1. However, the SNR in A1 was greater for the audiovisual condition in comparison to the auditory-alone and visual-alone conditions, suggesting the presence of multisensory enhancement in A1. Overall, our findings point to early multisensory processing in the human A1. The processing of either the auditory and visual stimulus in A1 was enhanced when both stimuli were presented simultaneously.

Acknowledgements: This research was supported by an NIH grant (NIH R01- EY025018) awarded to CH.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 535

Failure to account for extrinsic visual noise leads to suboptimal multisensory integration

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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Sensory information integration is often near-optimal (reliability-weighted averaging, e.g. Ernst and Banks, 2002, Nature), but recent reports of suboptimality emphasize the need for process models accounting for suboptimal behavior (Rahnev and Denison, 2018, BBS). In a previous study, when combining sensory and prior information, suboptimal behavior was better fit by a model weighting information according to intrinsic noise only (internal to the observer, e.g. sensory noise) rather than one that accounted for both intrinsic and extrinsic noise (external to the observer, e.g. a stochastic cue) (Kiryakova et al., 2019, BioRxiv). We explicitly tested this hypothesis in a sensory cue-combination task. Twenty participants used auditory (400ms white noise burst) and visual (4-dot cloud) cues to find a hidden virtual object. Dots were drawn from one of two Gaussian distributions and centered on the true location (low/high variance intrinsic-only cues). Error distributions for visual cue-only trials were used for participant-by-participant calibration, where we added extrinsic noise to the low variance condition (shifting the dot cloud) such that intrinsic+extrinsic and intrinsic-only cues were equally reliable. Our hypothesis predicts near-optimal behavior in intrinsic-only trials but suboptimal behavior in intrinsic+extrinsic trials. We tested this by comparing the weight placed on visual cues (obtained by regressing visual bias against visual-auditory conflict) to the optimal prediction (based on single cue performance). Weight placed on the intrinsic-only cue did not differ significantly from optimal ($p = .351$). Weight placed on the intrinsic+extrinsic cue was significantly higher than optimal ($p < .001$), but significantly lower than an optimal prediction that ignored extrinsic noise ($p = .014$). Our results show that under-accounting for extrinsic noise can cause suboptimal perception and decision-making. Human perceptual systems may be well equipped to account for intrinsic uncertainty, but accounting for extrinsic uncertainty is more challenging, possibly in part because this uncertainty must be learned.

Acknowledgements: This project was funded by the Leverhulme Trust: RPG-2017-097.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 880

Mapping Audio-Visual Crossmodal Interactions in the Visually Impaired

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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Crossmodal incursion associated with partial vision loss may affect auditory-visual processing in those with low vision as compared with the normally sighted. In particular, crossmodal plasticity during and following vision loss modifies auditory-visual connections, potentially causing the integration of crossmodal information to differ across visual field locations. A visual flash detection task and a double flash task were performed with 24 stimuli locations, eight each equally spaced circumferentially at 5, 10, and 15 degrees from fixation. The visual flash detection task tested sensitivity to the visual flashes used in the double flash task (5 flash present trials, and 1 flash absent trial in each location). The double flash task had 10 trials in each visual flash detection location. The patient responses were segregated spatially based on the visual flash detection task, enabling the evaluation of regions with visual perception surrounded by vision loss. Patients 1 and 2 have monocular impairment due to impact trauma and optic nerve disease, respectively (eyes tested separately). Nine naive sighted participants were also tested as controls (with both eyes open). The eye with vision loss exhibited significantly stronger double flash perception relative to the eye with normal visual perception (Patient 1 only, and locations with 5/5 flash detections only). Also, the eyes with vision loss in both patients exhibited significantly stronger double flash perception than controls (only locations with 5/5 flash detections were included). The stronger double flash perception observed in the eye with low vision as compared with the control eye could be due to diminished visual responses, ocular dominance differences, or crossmodal interactions early in the visual pathway (prior to merging of the binocular inputs, for example in LGN). This pilot data is suggestive of the potential reweighting of audition and vision, and the spatial redistribution of crossmodality, as visual perception is lost.

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Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1768

Mechanisms leading to increased visual awareness for multisensory stimuli

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

Matilda Cederblad[1] (m.cederblad@abdn.ac.uk), Juho Äijälä, Leah Lousaing, Søren Andersen, Arash Sahraie; [1]University of Aberdeen

A combined presentation of a weak visual target and an auditory tone leads to quicker, more accurate responses, and a higher subjective report of signal intensity (e.g., visual awareness). This phenomenon has been suggested to be due to either multisensory integration or a rise in attention (arousal), with more alertness induced by the combined stimuli. To explore these alternative explanations, we conducted three experiments in which Continuous Flash Suppression (CFS) was used to manipulate awareness of visual targets that were presented on their own or together with a brief tone. Processing speed and awareness were measured in experiments 1 and 2 on a trial by trial basis. The findings indicate that the presence of a tone was associated with faster responses and more instances of awareness of the visual target, even when the tone was not task-relevant. In a third experiment we specifically addressed the relationship between detection of location of a visual target with presence/absence of an auditory informative (spatially congruent), uninformative or misdirecting (spatially incongruent) sound. Analysis of detection scores point towards a multisensory integration explanation as spatial congruency between the auditory and visual targets was associated with a combination of improved detection and increased awareness. When the tone was incongruent or uninformative both detection and instances of aware responses were higher than when the visual target was presented alone, which is consistent with the explanation based on the effect of attention. In conclusion, the effect of speeded processing, increased detection and higher instances of subjective report of awareness of the visual targets could be explained by both multisensory integration and a rise in attention/alertness.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 785

Multisensory effects on causal perception

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

Kayla Soma Tsutsuse[1] (kaylast@hawaii.edu), Jonas Vibell[1], Scott Sinnett[1]; [1]University of Hawaii at Manoa

Previous research has shown that visual perception is influenced by Newtonian constraints. For instance, Kominsky et al. (2017) showed that humans can detect unnatural collision events at a faster rate, where objects break Newtonian motion constraints by moving at a faster speed after colliding with another object, compared to collisions that do not violate Newtonian constraints. Their results provide evidence that the perceptual system distinguishes between realistic and unrealistic causal events. However, collisions between two objects are rarely silent in the real-world. The present study extends this research by adding a sound at the collision point between two objects to evaluate how multisensory integration influences the perception of colliding events that either follow or violate Newtonian constraints. To accomplish this, participants viewed an array of three simultaneous videos, each video depicting two moving objects. Two of the videos showed discs that moved at the same speed in a horizontal back and forth motion, and an oddball video of discs that either moved faster before the collision and slower after (natural) or slower before the collision and faster after (unnatural), thereby violating Newtonian motion constraints in the latter. Participants were asked to indicate the oddball video via keypress. Results demonstrate that participants were faster and more accurate when identifying natural events that included sound compared to silent conditions. However, similar results were found when participants responded to unnatural conditions with no sound at the collision point in comparison to conditions with a sound. These findings suggest that the addition of a sound to the unnatural events lead the perceiver to view them as being more realistic, even though they continue to violate the constraints of the physical world. Furthermore, this provides evidence of the complexity of interactions that influence the human visual perceptual system and its ability to perceive causal events.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1759

Multisensory expectations about dynamic visual objects facilitates early sensory processing of congruent sounds

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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In everyday life, visual objects are often accompanied by sounds, yet little is known about how information in one sense may influence the processing of information in another sense. We examined how dynamic visual input – an object moving continuously across the visual field – influences early auditory processing of a sound that is either congruent with the object's motion, and thus likely perceived as being part of the visual object, or incongruent with the object's motion. We recorded EEG activity from 31 neurotypical adults who passively viewed a red ball that appeared either on the far left or right edge of the display and continuously traversed along the horizontal midline to make contact and bounce off the opposite edge. For multisensory trials, a tone accompanied the visual input the moment the ball made contact with the opposite edge (AV-synchronous), or the sound occurred 450ms before contact (AV-asynchronous). We also included audio-only and visual-only trials. Our main analysis focused on the auditory-evoked event-related potential (ERP) measured at frontal electrode sites and revealed reliable differences in the amplitude and latency of the N1-P2 auditory complex (all p's < 0.003). Follow-up pairwise comparisons showed a reduced N1-amplitude for the AV-synchronous condition relative to the AV-asynchronous and audio-only conditions, and a delayed latency for the AV-asynchronous condition relative to the AV-synchronous and audio-only conditions. P2-peak analyses revealed greater amplitude for the audio-only relative to the AV-synchronous and AV-asynchronous and delayed latency toward AV-asynchronous relative to AV-synchronous and audio-only conditions. Overall, these results show that audio-visual synchrony elicited a faster and attenuated early auditory response relative to asynchronous or auditory-only events. This suggests that dynamic visual stimuli can help generate expectations about the timing of auditory events, which then facilitates the processing of auditory information that matches these expectations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

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Abstract ID: 431

Spoken Moments: A Large Scale Dataset of Audio Descriptions of Dynamic Events in Video

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

Mathew Monfort[1] (mmonfort@mit.edu), SouYoung Jin[1], David Harwath[1], Rogerio Feris[2], James Glass[1], Aude Oliva[1]; [1]MIT, [2]IBM Research

When people observe events they are able to abstract key information and build concise summaries of what is happening. These summaries include contextual and semantic information describing the important high-level details (what, where, who and how) of the obseved event and exclude background information that is deemed unimportant to the observer. With this in mind, the descriptions people generate for videos of different dynamic events can greatly improve our understanding of the key information of interest in each video. They provide expanded attributes for video labeling (e.g. actions/objects/scenes/sentiment/etc.) while allowing us to gain new insight into what people find important or necessary to summarize specific events. In this vein, we present a new dataset of audio descriptions collected for a set of 500K different short videos depicting a broad range of different events. We collect our descriptions using audio recordings to ensure that they remain as natural and concise as possible and provide verified text transcriptions of each recording. We additionally present a multi-modal audio-visual model for jointly learning a shared representation between the video and the audio descriptions and show how this learned representation can be applied to a number of different tasks in video understanding.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1447

The effect of auditory cues on visual learning in multisensory perceptual training in virtual reality

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

Catherine A. Fromm[1] (caf8588@rit.edu), Kelsey E. Murphy[1], Melissa J. Polonenko[2], Ross K. Maddox[2], Krystel R. Huxlin[2], Gabriel J. Diaz[1]; [1]Rochester Institute of Technology, [2]University of Rochester

Visual training improves performance in visually-intact and visually-impaired participants, making it useful as a rehabilitation tool. An interesting question in rehabilitation is whether invoking multisensory integration could increase training efficacy. Four visually-intact subjects (three female) were included in a 10-day training experiment in which they repeatedly performed a 4-way direction discrimination task. In this task, a gaze-contingent, 5degree diameter visual global motion stimulus was presented at 10degree azimuth/elevation in virtual reality (VR), using the HTC Vive Pro Eye head-mounted display with integrated eye-tracking. The stimulus could move along one of four oblique directions. Two subjects trained with only visual stimulation (V group). The other two subjects trained with an accompanying pulsed white-noise auditory cue (AV group) moving in VR along the horizontal component of the visual motion, rendered with the SteamAudio 3D audio spatializer. Visual task difficulty was manipulated with a staircase by changing the range of directions in which dots could move around the principal direction of motion in the visual stimulus. The staircase level was determined only by correct judgment of the vertical component of motion. Direction range thresholds (DRT) were computed daily. The mean (+/- standard deviation) slope of DRT on the overall judgement across 10 days was 2.1+/-2.3degrees for the AV group and 1.9+/-0.9degrees for the V group (n=2 each). Visual-only pre- and post-tests showed an average change in DRT of -3.5+/-0.7degrees for the AV group, and 33.5+/-19.1degrees for the V group. This suggests that AV subjects learned to rely on the auditory cue for overall task performance and failed to improve their skill on the purely visual component. Once the auditory cues were removed, performance in the AV group dropped to pre-training levels. Thus, adding even an informative auditory cue to a visual task may impair rather than enhance visual learning under certain conditions.

Acknowledgements: Unyte Foundation Pipeline to Pilot

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 867

The effects of cross-modal feature and location mappings on visual performance

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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Previous research has shown that hearing a sound improves visual processing of objects appearing at the same location (Störmer, 2019). Another line of research has suggested that, beyond these spatial effects, cross-modal mappings exist through natural associations between certain auditory and visual features. For example, high-pitched sounds tend to be associated with bright visual stimuli and low-pitched sounds with dark stimuli (Marks, 1987). However, it is unclear whether these cross-modal feature mappings influence visual perception in a similar way as has been found in the spatial domain, i.e., improving perception for congruent (relative to incongruent) sound-object pairs. We tested this by asking participants ($N = 32$) to perform a cross-modal visual discrimination task in which they were briefly shown a bright or dark disk either on the left or right side of a screen. Participants indicated whether they saw a small gap inside the disk and also which disk type was presented (bright or dark; 4-alternative forced choice). Critically, on each trial, the disk was preceded by a peripheral high- or low-pitched sound from the right or the left side of the screen that was not predictive of the spatial location or the brightness of the disk. Participants showed higher visual discrimination accuracy for both congruent spatial cues ($p = 0.005$, $d = 0.53$) and congruent feature cues ($p = 0.008$, $d = 0.50$; no interaction, $p = 0.146$). The results show that peripheral sounds facilitate the processing of co-localized visual stimuli, replicating previous studies. Further, they demonstrate that audiovisual feature associations, such as pitch and brightness, can have similar effects on accuracy in a visual discrimination task, at least when the visual feature (brightness) is task-relevant. In order to address the possibility of response bias, further research should assess the facilitatory effect of feature cues when brightness is task-irrelevant.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1578

Visual Experience influences associations between Pitch and Distance, but not Pitch and Height

Poster Presentation - *Topic area: Multisensory Processing: Visuo-auditory interactions*

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Background: Cross-modal correspondences are widespread intuitive associations between seemingly unrelated sensory dimensions, such as auditory pitch and spatial elevation. Congruent pairings such as high-pitch with high-elevations influence looking patterns in infants, as well as sensory processing speeds in adults. In previous studies, increased pitch has been put with elevation in the sighted but proximity in the blind, and implicit association tasks show that pitch only corresponds to tactile elevation in the sighted but not the blind. Thus, it is unclear whether pitch-elevation would be present for blind individuals in a purely auditory task. Method: Sighted (N=93), late-blind (N=46), and early-blind (N=50) completed a standard auditory implicit association task between tonal-pitch (low, high) and speech indicating either height (“below”, “above”) or distance (“further”, “closer”). The dependent variable was a D-Score (ranging from +2 to -2) based on reaction time and errors indicating whether there were preferences for congruent or incongruent pairings. Results: ANOVAs revealed that for pitch-height all groups showed a preference for high tonal pitch with “above,” with no significant effects of sightedness, stimuli order, or interaction. However, early-blind subjects showed the strongest preference for congruent pitch-height pairings. For pitch-distance, subjects significantly differed according to both group and order (but not interaction), Bonferroni-corrected post-hoc tests revealed that sighted controls had a significantly stronger pitch-distance association (high with “closer”) than both the early-blind and late-blind subjects and that, when group and stimuli-order are considered, the early-blind showed significantly stronger preferences for whichever pairing was shown first. Discussion: We provide the strongest evidence to date of pitch-height correspondences persisting across groups varying in sightedness. We also provide evidence of sightedness influencing pitch-distance correspondences with the early-blind being uniquely susceptible to ordering effects. This research adds to the growing body of evidence on how visual experience influences multisensory associations.

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Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1316

Multisensory processing: Somatosensory, vestibular, gustatory

Contributions of vision, gravity, and the body during misestimations of orientation

Poster Presentation - *Topic area: Multisensory processing: Somatosensory, vestibular, gustatory*

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When immersed in an upright (relative to them) visual scene, supine or prone viewers can experience a visual reorientation illusion (VRI) where they actually feel upright. When people report a VRI, visually-induced self-motion (vection) is enhanced (McManus & Harris, 2019 VSS). This might be due to 1) higher visual weightings in individuals who report a VRI compared to those who do not, or 2) a misinterpretation of the vestibular cue as motion instead of tilt or 3) a greater sensitivity to visual-vestibular conflict. Here we investigated the connection between VRIs and sensory weighting using virtual reality. Participant's sensitivity to VRIs was measured over 1 minute where they continuously pressed a button if they perceived themselves as upright while lying supine (VRI) with an upright display. They were divided into VRI and non-VRI groups. The perceptual upright (PU) was then measured while sitting or lying on their side to obtain the weightings of vision, body, and gravity. Participants reported whether an ambiguous symbol in various orientations appeared as a "p" or "d" as the visual background orientation was varied. The PU was defined as midway between the orientations of maximum ambiguity and the weighting of each cue determined. The weightings of vision (mean difference= 6.22%, SE= 5.89, p=0.301) and body (mean difference= 4.45%, SE= 7.32, p=0.55) did not differ between the VRI and non-VRI groups, however the VRI group had a significantly higher weighting of gravity (mean difference= 10.67%, SE= 4.23, p=0.03). It appears that despite their reported orientation being more influenced by visual cues and enhanced vection, VRI-sensitive people's perceptual upright is more influenced by gravity. This finding is counter to the conclusion by Howard and Hu (2001) who supposed that during a VRI participants must be ignoring the gravity vector and perhaps indicative of greater sensitivity to conflict.

Acknowledgements: LRH is supported by a Discovery Grant from the Natural Sciences and Engineering Research Council (NSERC) of Canada and the Canadian Space Agency. MM holds a research studentship from the NSERC CREATE program.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 886

Crossmodal metaperception: Visual and tactile confidence share a common scale

Poster Presentation - *Topic area: Multisensory processing: Somatosensory, vestibular, gustatory*

Lena Klever[1,2] (lena.klever@psychol.uni-giessen.de), Marie Mosebach[1], Katja Fiehler[1,2], Pascal Mamassian[3,4], Jutta Billino[1,2]; [1]Justus-Liebig-University Giessen, [2]Center of Mind , Brain, and Behavior (CMBB), University of Marburg and Justus Liebig University Giessen, [3]Laboratoire des Systemes Perceptifs, CNRS UMR 8248, Paris, [4]Institut d'Etude de la Cognition, Ecole Normale Superieure, PSL University , Paris

Perceptual confidence refers to our ability to estimate the validity of our perceptual decision. There is robust evidence that observers have access to a reliable estimate of their own uncertainty when making perceptual decisions. However, so far, evidence is still scarce whether metaperception qualifies as a common mechanism that can monitor decisions across different sensory modalities. In previous work, it has been suggested that perceptual confidence can be evaluated on an abstract scale that is not only task-independent, but also modality-independent. We aimed to scrutinize these findings by measuring visual contrast and tactile vibration discrimination thresholds in a confidence forced-choice task. A total of 26 participants were involved in our study. We determined thresholds for trials in which perceptual judgments were chosen as confident and for those that were declined as confident. Confidence comparisons were made between perceptual decisions either within the visual and tactile modality, respectively, or across both modalities. Furthermore, we assessed executive functions in order to explore a possible link between cognitive control and metaperceptual capacities. We found that perceptual performance was a good predictor of confidence judgments and that the threshold modulation was similarly pronounced in both modalities. Most importantly, participants compared their perceptual confidence across visual and tactile decisions with the same precision as within the same modality. These findings are supported by a Bayesian Repeated Measures ANOVA favouring the null model as the best fitting model. However, we observed substantial variability of confidence sensitivity and executive functions across our participants. We suggest that individual differences in executive functions might provide a critical resource that determines metaperceptual ability. In conclusion, our findings corroborate that perceptual uncertainty can be accessed on an abstract scale and that it can be used to make confidence judgments across sensory modalities.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for your interest in our work!
Feel free to contact me by email if you have further questions about the project: Lena.Klever@psychol.uni-giessen.de

Abstract ID: 1097

Materials in action: The look and feel of soft

Poster Presentation - *Topic area: Multisensory processing: Somatosensory, vestibular, gustatory*

Müge Cavdan[1] (muege.cavdan@psychol.uni-giessen.de), Knut Drewing[1], Katja Doerschner[1,2,3]; [1]Justus-Liebig University Giessen,Germany, [2]Bilkent University, Ankara, Turkey, [3]National Magnetic Resonance Research Center, Bilkent University, Ankara,Turkey

In daily life, we can perceive the softness of objects through vision and touch: We can touch a rabbit’s fur, or we can visually perceive its softness by looking at a picture. Alternatively, watching someone else petting the rabbit, not only lets us see how the material reacts to touch but might also trigger us to experience hand motions and consequences of the interaction vicariously –possibly leading to a much more vivid experience of the fur’s properties. Previously, we have shown that different dimensions such as granularity, deformability, and viscosity underlie what we haptically perceive as being soft. Here, we investigate how these softness dimensions, compare to those available from static- and dynamic visual cues. Participants rated attributes of everyday materials, such as elasticity, velvety-ness etc. under three conditions: in the haptic condition, blindfolded participants explored and rated materials, while we recorded their hand movements. In the static visual condition participants rated the attributes on close-up images depicting the same materials, and in the dynamic visual condition participants performed ratings while viewing the videos recorded in the haptic condition. Principal component analysis revealed that the three perceptual spaces constructed from visual static, - dynamic, and haptic judgments were similar, in that each was comprised of a granularity, a viscosity, and a deformability dimension. However, only the dynamic visual condition yielded a furriness dimension, and only the haptic condition yielded a roughness dimension. Explained variance was higher for haptic and dynamic visual conditions than for the static visual one. Finally, Procrustes analyses revealed a high similarity between haptic and dynamic visual spaces, and only moderate similarity between static visual and haptic spaces and static visual and dynamic visual spaces. Taken together, these results suggest that dynamic cues available through haptic and visual exploration provide similar information about material properties.

Acknowledgements: This work was supported by EU Marie Curie Initial Training Network “DyVito” (H2020-ITN, Grant Agreement: 765121).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 514

Neuroimaging in the Blind with Retinal Prostheses: Does Sensory Reorganization During Blindness Limit Visual Restoration?

Poster Presentation - *Topic area: Multisensory processing: Somatosensory, vestibular, gustatory*

Noelle Stiles[1] (nstiles@usc.edu), Jeiran Coupan[2], Negin Nadvar[3], Hossein Ameri[1], James Weiland[3,4], Vivek Patel[1], Yonggang Shi[2]; [1]Department of Ophthalmology, University of Southern California, [2]Stevens Neuroimaging and Informatics Institute, Department of Neurology, University of Southern California, [3]Department of Biomedical Engineering, University of Michigan, [4]Department of Ophthalmology and Visual Sciences, University of Michigan

Background: Argus II retinal prostheses restore limited visual perception to the blind by stimulating still viable cells in the eye with an implanted device; nevertheless, the patient outcomes can be quite variable. Therefore, we are studying the factors that could be limiting patient rehabilitation and long-term outcomes. In particular, the senses reorganize during blindness, allowing for tactile information to be processed in visual brain regions. We are investigating whether this sensory reorganization prevents the normal processing of visual information once retinal prostheses are implanted. Methods: Argus II patients (N=6) and blind controls (N=5) performed tactile shape and roughness tasks in a Siemens 3T MRI scanner. Four of these Argus II patients also performed psychophysical tasks outside the scanner. Results: On average the six Argus II post-implantation patients had tactile incursion of early visual cortex after partial visual restoration, implying that visual cortex is not fully reclaimed for visual processing alone following visual restoration. Four of the Argus II post-implantation patients with data from psychophysical tasks, showed a significant anti-correlation between their behavioral Argus II visual shape matching performance (outside the scanner), and the amount of tactile repurposing of visual cortex (tactile-only fMRI task). Effectively, the patients that are the most functional with the Argus II visual prosthesis had the least amount of tactile activation (reorganization) of visual cortex. Discussion: The Argus II patient fMRI results imply that partial visual restoration does not completely reverse sensory reorganization from blindness. Instead, restored vision seems to co-exist with crossmodal processing in primary visual cortex. Furthermore, a preliminary correlation analysis indicates that this reorganization may be maladaptive to the rehabilitation of visual perception. If sensory reorganization limits visual restoration, patient outcomes may be improved with training that aims to limit reorganization of the senses during blindness, as well as reverses it after visual restoration.

Acknowledgements: We are grateful for support from the National Institutes of Health, the Philanthropic Educational Organization Scholar Award Program, and Arnold O. Beckman Postdoctoral Scholars Fellowship Program.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 892

Successful Outcomes in a Stroop Test Modulate the Sense of Agency When the Human Response and the Preemptive Response Actuated by Electrical Muscle Stimulation are Aligned

Poster Presentation - *Topic area: Multisensory processing: Somatosensory, vestibular, gustatory*

Daisuke Tajima[1] (daisuke.b.tajima@sony.com), Jun Nishida[2], Pedro Lopes[2], Shunichi Kasahara[3,4]; [1]Sony Corporation, [2]Chicago University, [3]Sony Computer Science Laboratory, [4]The university of Tokyo

The sense of agency (SoA) refers to the sensation that I caused the action. Generally, one would expect that if moved passively by an external force, one would not feel an SoA. However, Kasahara (2018) have found that by using precise timing, the SoA was elicited even for EMS-actuated preemptive passive body movement in a simple reaction time task. This effect however only has been verified in the specific situation where the participant and the EMS device share the same goal of action. (i.e., both participant and device press a button as fast as possible). Here, we studied a more complex situation where a participant cooperates with an EMS-based device to perform a choice-task. In this case, device and participants' answers will not always be aligned, e.g., at times the EMS-based device can choose the wrong answer or vice versa. We hypothesized that, If the underlying mechanism of the SoA would prefer to depend on the cognitive process of verifying the goal of own action and the outcome retrospectively, the apparent in/correct outcomes modulate the participant's SoA. Participants performed two-alternative forced choice tasks of the Stroop-test by tapping with both hands and the EMS also actuated the participant's hand to respond to the task, faster or slower than the participant's voluntary movement. The EMS played two roles: assistive (forced success) or adversarial (forced failure). The result showed that, when the participant's response and the EMS response were aligned, the SoA was significantly higher when the outcome was success rather than failure. In contrast, when their responses were not aligned, the SoA was elicited only when the outcome reflected the participant's response regardless of the EMS' response.

These results support our hypothesis partly and imply that only when the outcome is sensed as one's action, its outcome modulates the SoA postdictively.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 173

Testing predictive processing as an account of visually driven responses to real-world objects in primary somatosensory cortex

Poster Presentation - *Topic area: Multisensory processing: Somatosensory, vestibular, gustatory*

Fraser Smith[1] (fraser.smith@uea.ac.uk), Ethan Knights[2], Janak Saada[3], Stephanie Rossit[1], Kerri Bailey[1]; [1]University of East Anglia, [2]MRC Cognition and Brain Sciences Unit, Cambridge, [3]Norfolk and Norwich University Hospitals NHS Foundation Trust

Neurons, even in earliest sensory regions of cortex, are subject to a great deal of contextual influences from both within and across modality connections. Recently we have shown that primary somatosensory cortex (SI) - in the total absence of tactile stimulation - contains discriminable information about object categories presented via vision or audition (i.e. images of familiar graspable objects or sounds of hand-object interactions). Here we sought to address whether Predictive Processing may underlie why SI contains information triggered via distal modalities. On each trial of a functional imaging experiment, 18 participants first viewed one of two real-object stimuli (tennis ball or cup, matched for grip aperture), followed by either the same matching or mismatching stimulus. At the target phase the stimulus could hence be congruent or incongruent with the prime stimulus, and participants either just viewed the target or reached out to touch with their right hand. We defined a region of interest spanning the whole of SI and SII in each participant and also tactile sensitive voxels in Left S1 from an independent localizer in a subset of participants (N=7). We predicted that SI would show decreased responses and better representations in the case of congruent vs incongruent touch trials. Against our prediction, we only found significant decoding in the incongruent touch condition in both SI and SII when the whole region was considered. Intriguingly when only tactile sensitive voxels in Left S1 were included, the pattern flipped with significantly better decoding in the congruent condition. We discuss our findings with respect to Predictive Processing operating across sensory modalities but also to alternative accounts that suggest stimulus repetition leads to weaker representation.

Acknowledgements: This work was funded by grant (SRG\171430) from the British Academy to FW Smith and S Rossit.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1816

Viewing pictures of foods elicits taste-specific activity in gustatory insular cortex

Poster Presentation - *Topic area: Multisensory processing: Somatosensory, vestibular, gustatory*

Jason A. Avery[1] (jason.avery@nih.gov), Alexander G. Liu[1], John E. Ingeholm[1], Stephen J. Gotts[1], Alex Martin[1]; [1]National Institute of Mental Health

Grounded theories of cognition claim that the neural substrates involved in object perception support both the perceptual and conceptual processing of those objects. Thus, the conceptual representation of food should involve brain regions associated with taste perception. This idea is supported by previous human neuroimaging research showing that viewing pictures of food (vs. non-food objects) activated taste-responsive regions of the insular cortex, thus suggesting that these pictures trigger an automatic retrieval of taste property information associated with the depicted foods. While suggestive, these findings do not indicate whether these representations contain specific information about the taste qualities of the depicted foods (i.e. whether a food is predominantly sweet, sour, or salty). To explore this question, we examined food-related responses within the human brain using ultra-high resolution functional magnetic resonance imaging (MRI) at high magnetic field strength (7-Tesla). During scanning, participants tasted sweet, salty, sour and tasteless liquids, delivered via a custom-built MRI-compatible tastant-delivery system. In a separate task, subjects also viewed pictures of a variety of sweet, salty, and sour foods, as well as non-food objects. As previously observed, all tastes (vs. tasteless) activated gustatory cortex within the dorsal mid-insula, a region also activated when subjects viewed pictures of food (vs. non-food objects). Using multivoxel pattern analysis, we were able to decode the taste category associated with these food pictures within this mid-insula region as well as from a region of oral somatosensory cortex. A multivariate searchlight analysis also decoded the picture-associated taste category in orbitofrontal cortex and the amygdala - regions located downstream in the taste pathway. These results suggest that these food representations, located within the neural structures involved in taste perception, contain information specific to the sensory qualities of visually depicted foods.

Acknowledgements: This study was supported by the Intramural Research Program of the National Institute of Mental Health, National Institutes of Health.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 882

Numerosity

Adaptation to hand-tapping affects directly sensory processing of numerosity

Poster Presentation - *Topic area: Numerosity*

Roberto Arrighi[1] (roberto.arrighi@gmail.com), Paula Maldonado[1], Guido Marco Cicchini[2], David Burr[1,2]; [1]University of Florence, Florence, Italy, [2]Institute of Neuroscience, National Research Council, Pisa, Italy

Several studies have demonstrated that numerosity perception is susceptible to adaptation: after exposure to high numerosities, participants underestimate the numerosity of subsequently patterns, and over-estimate after adaptation to low numerosities. We have recently shown that motor routines such as hand-tapping also affect numerosity estimates, and that the motor adaptation is confined to the tapping region, pointing to shared mechanisms encoding the quantity of both internally generated actions and externally generated events. However, it has been suggested that adaptation studies may reflect response biases rather than alteration of sensory processing. To disentangle the two possibilities, we studied visual and motor adaptation on numerosity perception (determined by the point of subjective equality in a 2AFC discrimination task), while also measuring participant confidence and reaction-times. If adaptation occurs at the sensory level, peaks in reaction-times and troughs in confidence should shift with adaptation to follow the new PSE, where the stimuli are most difficult to discriminate (Gallagher et al., 2019). On the other hand, if they result from response biases when confidence is low, the confidence (and also reaction-time) curves should remain centered at the unadapted PSE after adaptation. We replicate previous studies showing that both sensory and motor adaptation robustly distort numerosity estimates by 23% and 14% respectively. Importantly, in both cases, the shifts in perceived numerosity were almost perfectly mirrored

by shifts in confidence and reaction-times, with the maximum uncertainty and longest response-times occurring at the point of subjective equality rather than at the point of physical equality. Taken together our results suggest that both forms of numerosity adaptation do not arise by decisional processes but directly act on the sensory representation of numerosity

Acknowledgements: This research was funded by EU Horizon 2020 – ERC Advanced “Spatio-temporal mechanisms of generative perception”, Grant number 832813 – GenPercept and by the Italian Ministry of Education, University, and Research under the PRIN2017 programme (Grant number 2017XBJN4F—‘EnvironMag’)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

To all of you that needs further information please have a look at the published article here https://royalsocietypublishing.org/doi/full/10.1098/rspb.2020.0801.

Abstract ID: 1036

Attention modulates numerosity responses in human parietal cortex

Poster Presentation - *Topic area: Numerosity*

Yuxuan Cai[1,2] (yuxuancai0830@gmail.com), Shir Hofstetter[1], Ben M. Harvey[3], Serge O. Dumoulin[1,2,3]; [1]Spinoza Centre for Neuroimaging, Amsterdam, Netherlands, [2]Experimental and Applied Psychology, VU University Amsterdam, Amsterdam, Netherlands, [3]Experimental Psychology, Helmholtz Institute, Utrecht University, Utrecht, Netherlands

Numerosity, the set size of a group of items, helps to guide human behavior and decisions. We previously described numerosity-selective neural populations organized in systematic topographic maps in human occipital, parietal and frontal cortices (Harvey et al, 2013, 2017). However, it remains unclear whether numerosity-selective responses reflect stimulus properties only, or reflect which items are attended. Here, we investigate numerosity-selective responses when participants were presented with identical numerosity stimuli but paid attention to different item sub-sets within the stimulus. We measured responses to systematically varying numerosities using ultra-high field (7T) fMRI. The numerosity stimuli contained black and white dots, presented simultaneously. While the white dots systematically increased from 1 to 7 dots, the black dots systematically decreased from 26 to 20 dots, so the total numerosity remained constant at 27 dots. This stimulus sequence repeated with colors switched, then moved through the numerosity sequence in the opposite order. Subjects attended to either black or white dots, detecting a subtle dot shape change. No numerosity judgments were required. We summarized the fMRI signals using a

logarithmic Gaussian function with two parameters, preferred numerosity and tuning width, responding to the attended sub-set's numerosity. We fit these parameters to predict the measured responses, following a population receptive field (pRF) modeling approach (Dumoulin & Wandell, 2008). Each cortical location responded specifically to the attended numerosity, yielding very different response time courses to the same stimulus, depending which sub-set was attended. The same cortical location preferred similar numerosities when participants either attended to white or black dots. Numerosity-selective neural populations were topographically organized in both attention states. Our results suggest that identical numerosity stimuli give rise to different numerosity responses depending on the task the subject performs. Neural responses underlying the perception of numerosity are strongly modulated by attention and task demands.

Acknowledgements: This project has received funding from the Chinese Scholoarship Council (CSC) No. 201706750008

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York

Presenter's Message

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Abstract ID: 690

Correlation structure does not affect number judgment

Poster Presentation - *Topic area: Numerosity*

Ford Atwater[1] (fordatwater@gmail.com), Madison Elliott[1], Caitlin Coyiuto[2], Ronald Rensink[1]; [1]University of British Columbia, [2]Carnegie Mellon University

Past work showed a performance cost for discriminating two-class scatterplots formed of a "target" population and an irrelevant "distractor" population (Elliott, 2016). As long as a second population was present, discrimination was the same regardless of color similarity between the two, resulting in "all-or-nothing performance" (Elliott & Rensink, VSS 2019). When the same dots were randomly distributed in a numerosity estimation task, severe performance costs were found for similar target and distractor colors, but no cost for opposite-colored distractors, showing "graded performance" similar to that encountered in visual search (Duncan & Humphreys, 1989). A possible explanation for this difference is that the structured spatial distributions of stimuli in the correlation task differed from the random distributions in the number estimation task. This prompted us to investigate whether or not numerosity estimates would be affected by correlation structure, and vice versa. Observers performed two within-subjects tasks: a correlation task and

a numerosity discrimination task. Crucially, the stimuli were always the same: two-class scatterplots with target and distractor populations distinguished by color. Trial blocks were fully counterbalanced according to target dot number (50, 100, 150) and target dot correlation (.3, .6, .9). Distractor populations were always drawn with 100 dots at Pearson's r = .3. Results showed that correlation JND slopes were unaffected by number of dots in the target population, and JND intercepts increased as the number of dots decreased, consistent with one-class scatterplot performance (Rensink, 2017). Number JNDs increased with the number of dots, consistent with past findings (Feigenson et al., 2004). Critically, number JNDs did not vary with target correlation, showing that the structure and geometric density of the target population does not affect our ability to select and estimate number information.

Acknowledgements: UBC 4 year PhD fellowship

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1511

Monotonic responses to numerosity in human primary visual cortex reflect canonical visuospatial computations

Poster Presentation - *Topic area: Numerosity*

Jacob Paul[1] (j.m.paul@uu.nl), Tuomas ten Cate[1], Ben Harvey[1]; [1]Experimental Psychology, Helmholtz Institute, Utrecht University

Humans and many animals have neurons tuned numerosity, the number of items in a display. Numerosity tuned neurons respond selectively, decreasing in response amplitude with distance in either direction from a peak preferred numerosity. How numerosity-tuned responses are derived from visual images remains unclear. Computational models suggest an initial monotonic stage where response amplitude increases with numerosity. Recent evidence suggests this monotonic stage may occur in primary visual cortex. Here we used ultra-high-field 7T fMRI and population receptive field (pRF) modelling to characterize the location and nature of these responses. During scanning, we displayed visual stimuli containing black circles whose numerosity changed between one and seven in ascending and descending order. Different stimulus configurations controlled for covarying visual features such as luminance, edge density and item size. We quantified monotonic responses with a general linear model that increased response amplitude proportionally to log(numerosity). We used pRF visual field mapping to identify visual field map borders

and quantify eccentricity preferences for each voxel. In all stimulus configurations, a monotonic response model closely predicted responses in primary visual cortex (V1-V3). Explanatory power was highest in V1 and progressively decreased into extrastriate cortex. Model fit depended critically on the eccentricity preference of each voxel, with goodness-of-fit progressively decreasing as pRFs covered less of the stimulus area. Normalized stimulus luminance and contrast predict very similar responses to numerosity, and capture V1's responses even more closely. Our findings indicate monotonic responses to numerosity are already established by V1 and inherited by subsequent processing stages. We discuss how basic neural computations in primary visual cortex (such as divisive normalization or surround-suppression) could drive such monotonic responses. These canonical operations may provide a simple, biologically plausible mechanism linking established low-level response properties of V1 with numerosity perception and higher-level numerosity-tuned responses in association cortices.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for your interest in my poster. If you have any questions relating to this project, please feel free to leave a comment in the Chat area and I will respond to these periodically throughout the conference. Additionally, you can contact me via email or on Twitter. Enjoy the rest of the conference and hope to see you back at St Pete Beach in the future!

Email: j.m.paul@uu.nl
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Abstract ID: 472

Neural numerosity selectivity changes after visual numerosity adaptation

Poster Presentation - *Topic area: Numerosity*

Andromachi Tsouli[1,2] (a.tsouli@uu.nl), Yuxuan Cai[2,3], Martijn van Ackooij[1], Shir Hofstetter[2], Ben M. Harvey[1], Susan F. te Pas[1], Maarten J. van der Smagt[1], Serge O. Dumoulin[1,2,3]; [1]Utrecht University, Utrecht, The Netherlands, [2]The Spinoza Centre for Neuroimaging, Amsterdam, The Netherlands, [3]VU University, Amsterdam, The Netherlands

The perception of visual numerosity (i.e. the set size of a group of items) is an evolutionarily preserved ability found in humans and animals. A useful method to infer the neural underpinnings of a given perceptual feature is sensory adaptation. Numerosity is susceptible to adaptation, similarly to other visual

features. Recently, we have shown numerosity-selective neural populations with a topographic organisation in the human brain. Here, we investigated whether the numerosity selectivity of these neural populations changes during adaptation to visual numerosity. Using 7 Tesla ultra-high field fMRI, we scanned participants while they viewed stimuli which systematically changed in numerosity (1 to 7 dots with a baseline of 20 dots). In the adaptation conditions, the conventional numerosity stimuli were interleaved with a low or high numerosity adapter, consisting of 1 or 20 dots, respectively. We analysed the responses using custom-build population receptive field neural models of numerosity encoding, and compared estimated numerosity preferences between adaptation conditions. We replicated our previous studies where we found several topographic maps of numerosity-selective responses. During numerosity adaptation, we found that the numerosity preferences within the numerosity maps were biased towards the numerosity of the adapter. Specifically, and after adaptation to a low numerosity (1 dot), the numerosity preference of the numerosity maps was biased towards lower numerosities, whereas after adaptation to a high numerosity (20 dots), the numerosity preference of the numerosity maps was biased towards higher numerosities. These results suggest that the observed changes in numerosity-selective neural populations could contribute to the perceptual effects of numerosity adaptation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 486

Possible objects count: Perceived numerosity is altered by representations of possibility

Poster Presentation - *Topic area: Numerosity*

Chenxiao Guan[1] (chenxiao@jhu.edu), David Schwitzgebel[2], Alon Hafri[1], Chaz Firestone[1]; [1]Johns Hopkins University, [2]Vassar College

Our minds can represent not only how the world is, but also how the world could be. For example, when completing a jigsaw puzzle, we can appreciate not only the shapes of individual puzzle pieces, but also their potential to form a new object with a shape of its own: the complete puzzle that the pieces could make. What is the nature of this experience? Might such “possible” objects be treated like actual objects by mechanisms of attention and visual cognition? Here, we show that this is the case, by demonstrating a

surprising connection between possibility and perceived numerosity. Subjects saw brief displays of "puzzle piece" shapes, and were simply asked how many shapes were in each display (in particular, which of two displays had more). Crucially, the shapes appeared in pairs that either could or could not efficiently combine into new objects. For example, pieces with triangular protrusions appeared near pieces with triangular indents (such that they could combine into a single piece); or, pieces with triangular protrusions appeared near pieces with rectangular indents (such that they could not combine into a single piece). Remarkably, displays with combinable pieces were perceived as less numerous than displays with non-combinable pieces—as if the mind treated two geometrically compatible pieces as being the single object they could create. Follow-up experiments replicated this result in a larger sample, ruled out confounding geometric factors, and explored how configural processing produces these effects. For example, pairs of combinable pieces were also seen as less numerous when oriented inward (with compatible protrusions and indents facing each other) than when oriented outward (with compatible protrusions and indents facing away). We suggest that the mind confers objecthood not only on actual objects, but also on possible objects—and in ways that alter downstream visual processing.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 847

Systematic variation of laminar numerosity-tuning suggests information processing in parietal cortex analogous to V1

Poster Presentation - *Topic area: Numerosity*

Jelle van Dijk[1,2] (j.van.dijk@spinozacentre.nl), Alessio Fracasso[1,3,4], Natalia Petridou[3], Serge Dumoulin[1,2,5]; [1]Spinoza Centre for Neuroimaging, Amsterdam, NL, [2]Utrecht University, NL, [3]University Medical Center Utrecht, NL, [4]University of Glasgow, UK, [5]VU University, Amsterdam, NL

Numerosity refers to the set size of a group of items. We previously showed that numerosity-selective neuronal populations are organized in topographic maps in parietal cortex (Harvey et al., 2013). Recently, we demonstrated that visual population receptive field tuning varies systematically across cortical depth, similar to the signal processing between cortical layers (Fracasso, et al., 2016). Here, we combine both

methods to investigate cortical depth-dependent processing in higher-order cortex, specifically investigating whether numerosity-selective populations in parietal cortex follow a similar signal processing sequence across cortical depth. Participants (n=7) viewed dot patterns containing 1-7 or 20 dots that systematically varied over time while recording sub-millimeter fMRI responses from a numerosity map in the parietal cortex (Harvey et al., 2013). We estimated preferred numerosity (numerosity eliciting the highest response) and tuning width (numerosity range that elicit responses) for each voxel using computational modelling (Dumoulin, Wandell, 2008; Harvey et al., 2013). Even in sub-millimeter fMRI data, our model explains 28% (mean of best 20% of fits, range = 9-50%) variance of the data. We find topographic numerosity maps at all depths. Moreover, we show that tuning width increases with preferred numerosity, in line with previous findings (Harvey & Dumoulin, 2017; Harvey et al., 2013), and that this pattern is present at all cortical depths. We show that on average, tuning width follows an inverted U-shaped profile across cortical depth, indicating a sharpening of numerosity responses with increased laminar processing. Our results suggest that information processing across cortical depth in higher-order cortex is analogous to information processing in early visual cortex, but with a sharpening in tuning width across cortical depth in the parietal cortex instead of broadening. Despite the apparent discrepancy, we speculate that in both cases the change in tuning width reflects specific processing and signal pooling to extract more abstract features.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Dear visitor,
thank you for your interest in my work.
If you have any questions or want to catch up, please do not hesitate to contact me at j.van.dijk@spinozacentre.nl and/or join me at my brief presenter video conference (see details above).
Enjoy your time at V-VSS!
Best regards,
Jelle van Dijk

Abstract ID: 735

Visual adaptation reveals non-opponent multichannel coding for numerosity

Poster Presentation - *Topic area: Numerosity*

Lauren Aulet[1] (lauren.s.aulet@emory.edu), Stella Lourenco[1]; [1]Emory University

Visual numerosity is represented automatically and rapidly, but much remains unknown about the computations underlying this visual encoding. Although it has been suggested that numerosity is represented with opponent-channel coding, where all values are represented by the relative activity of two pools of neurons (i.e., those tuned to small and large numerosities), in contrast to multichannel coding where all values are represented directly (with separate pools of neurons for each numerosity), this suggestion has not been systematically investigated. Using adaptation, we assessed whether visual encoding of numerosity is better characterized by an opponent-channel or multichannel system. Critically, these systems make distinct predictions regarding the pattern of after-effects exhibited when adapted to an intermediate numerical value (50 dots). Opponent-channel coding predicts no after-effects because both pools of neurons adapt equally. By contrast, multichannel coding predicts repulsive after-effects, wherein numerical values smaller than the adapter are underestimated and those larger than the adapter are overestimated. Importantly, even if 50 does not reflect a perceptually intermediate value within the approximate number system, an opponent channel system nonetheless predicts symmetrical after-effects, regardless of the numerical range presented, contra the predictions for a multichannel system. Consistent with multichannel coding, adaptation to an intermediate value (50 dots) yielded repulsive after-effects. Specifically, participants underestimated stimuli ranging from 10-50 dots (Exp. 1A), and overestimated stimuli ranging from 50-250 dots (Exp. 1B). Taken together, these findings provide novel evidence that the visual encoding of numerosity is supported by a multichannel, not opponent-channel, coding system and raise important questions regarding the contributions of different cortical regions, such as the ventral and lateral intraparietal areas, to the representation of numerosity (Nieder & Merten, 2007; Roitman et al., 2007).

Acknowledgements: This work was supported by a National Institutes of Health (NIH) institutional training grant (T32 HD071845) to LSA.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 307

Object Recognition: Categories

Car expertise does not compete with face expertise during ensemble coding

Poster Presentation - *Topic area: Object Recognition: Categories*

Jisoo Sun[1] (js.sun727@gmail.com), Isabel Gauthier[1]; [1]Vanderbilt University

Car and face expertise are similar because they both engage holistic processing and they also compete with each other when objects from both categories are processed simultaneously. Competition occurs across a variety of tasks (visual search, discrimination in rapid visual streams, working memory tasks) and regardless of whether car distractors are task-relevant or not. Here, we investigate competition in an ensemble coding task. The relationship between single object recognition and ensemble coding is debated, but if ensemble coding relies on the same ability as object recognition, we expect cars to interfere with ensemble coding of faces as a function of car expertise. We measured 53 participants' ability to make judgments of variability about arrays of faces, in the presence of car or novel object distractors (called Ziggerins). On each trial, participants viewed two sequentially presented arrays of 4 faces and 4 distractors, judging which array had the more diverse faces regardless of distractors. Face-diverse arrays included 4 faces from different people while Face-repeated arrays included 4 faces of 2 different people. The distractors were 4 different cars or 4 different Ziggerins. We measured car expertise with the Cambridge Car Memory Test and the Vanderbilt Car Matching Test. We also measured object recognition ability with novel objects with a Matching Task and with the Novel Object Memory Test and face recognition ability with the Cambridge Face Memory Test. Ensemble coding performance with faces was strongly correlated across the two distractor conditions. Critically, we found evidence against competition as a function of car expertise during ensemble coding of faces, using both a difference score ($r=-.10$, $BF_{10}=.22$) or a regression approach ($r=-.07$, $BF_{10}=.19$) to index competition. The results suggest that ensemble coding, unlike single object recognition, is not susceptible to competition between different domains of similar expertise.

Acknowledgements: This work was supported by the David K. Wilson Chair Research Fund, Vanderbilt University and by NSF (SMA1640681)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 896

Decoding representations of food images within the ventral visual stream

Poster Presentation - *Topic area: Object Recognition: Categories*

Carol Coricelli[1] (ccoricelli@sissa.it), Kevin M. Stubbs[2], Raffaella I. Rumiati[1,3], Jody C. Culham[2,4]; [1]SISSA (Trieste, Italy), [2]Brain and Mind Institute, University of Western Ontario (London, Canada), [3]ANVUR (Rome, Italy), [4]Department of Psychology, University of Western Ontario (London, Canada)

Food represents one of the most rewarding stimuli present in nature since it is necessary for our survival. Neuroimaging studies have revealed food-selective activation across a broad network of human brain regions, including areas within the ventral visual stream implicated in recognition of visual stimulus categories, including objects and bodies. However, the nature of visual food representations has not been systematically explored. We used representational similarity analysis (RSA) on multivoxel pattern data from functional magnetic resonance imaging (fMRI at 3 Tesla) to investigate whether representations of food stimuli are distinct from those for other visual categories. Moreover, we examined the degree to which representations of food and other stimuli could be accounted for by low-level properties (i.e., similarity in retinal size, luminance, elongation, texture, or silhouette overlap). Healthy normal-weight individuals (n=22) performed a one-back task in the scanner while viewing colored pictures of different object categories (food, body parts, utensils, objects, scrambled images), matched for retinal size and where possible, familiar size in the real world. RSA was applied to regions of interest (ROIs) within the visual system (including early visual cortex, ventral occipito-temporal cortex and lateral occipito-temporal cortex LOTC), and within a food-selective region (orbitofrontal cortex, OFC). RSA revealed distinct activation patterns for food stimuli in each ROI; that is, food images evoked activation patterns similar to other food images but distinct from other object categories. Visual areas also showed distinctions between different categories of non-food stimuli (e.g., bodies vs. tools); whereas food-selective OFC did not, showing only a difference between food and non-food stimuli. Statistical evaluation of competing models suggested that the representation of food images was not simply related to low-level visual properties. Taken together, our results suggest distinct neural representations of food stimuli that warrant further study, ideally with real food rather than images.

Acknowledgements: Natural Sciences and Engineering Research Council of Canada, Canada First Research Excellence Fund “BrainsCAN” grant

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

For any feedback, question or clarification do not hesitate to contact either here in the chat or via email: ccoricelli at sissa dot it
Carol Coricelli will reply as soon as possible (CEST timezone)
Since there is no closed captioning, the written transcript of the talk can be requested via email: ccoricelli at sissa dot it

Abstract ID: 267

Decoding visual categorical information in MEG using a large and diverse number of naturalistic image stimuli

Poster Presentation - *Topic area: Object Recognition: Categories*

Yuvraj Sethi[1], Dimitrios Pantazis[1]; [1]McGovern Institute for Brain Research, Massachusetts Institute of Technology

Human vision is fundamentally a big data process in terms of both image content and neural data. Yet, MEG neuroimaging studies are typically conducted with small numbers of visual stimuli, which may not support generalization because they severely undersample the stimulus space. Here, we presented a set of 4,916 unique images, which contained 1000 images of indoor and outdoor scenes, 2000 images of multiple objects, and 1,916 images of singular objects (https://bold5000.github.io/). We recorded MEG data while a participant viewed these images over the course of 10 sessions (with overlap of images). We divided these images into four categories: faces vs objects, large scenes vs small scenes, multiple objects vs single object, and moving (action) vs static. Each subcategory had ~400-1000 images. We then performed time-resolved decoding using a linear support vector machine classifier to estimate the time series with which categorical content emerges in the human brain. Decoding results were robust, reaching 100% accuracy as early as 100-130ms from the onset of the stimuli for all categories, excluding the action vs. static category that yielded relatively weaker decoding results. Decoding time series for most categories remained near 100% for an extended period of time until 700ms after stimulus onset. Overall, our results indicate that decoding several visual categorical representations with MEG data is possible even with very large numbers of diverse naturalistic image stimuli. Our findings pave the way to future studies that will explore critical dimensions of scene processing in the human brain (geometry layout, large/small, crowded vs. sparse, and visual associations in general) using the same diverse data set of 4,916 images.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 2

Does the pITG demonstrate selective coupling during numeral processing in kindergartners? - An fMRI study of task-evoked connectivity

Poster Presentation - *Topic area: Object Recognition: Categories*

Benjamin Conrad[1] (ben.conrad@vanderbilt.edu), Gavin Price[1]; [1]Vanderbilt University

A putative “number form area” (NFA) in the ventral occipito-temporal cortex (vOTC) is suggested to preferentially process Arabic numerals. The development of selectivity in the vOTC is thought to be driven in part by an area’s unique set of axonal projections but also by repeated co-activation with distinct functional networks over experience. In adults performing number and arithmetic tasks, areas of the right posterior inferior temporal gyrus (pITG) are selectively coupled to sites in the intraparietal sulcus (IPS), a region involved in magnitude processing. It is unclear when in development selective, task-evoked pITG connectivity emerges. To investigate this, we analyzed fMRI data from 47 typically-developing children (6.2 ± 0.4 years, 23 female), who performed symbol classification (digits, letters, scrambled) and symbolic (digits) and nonsymbolic (dots) comparison tasks in the scanner. Surface-based, beta-series correlation analyses were conducted to measure task-evoked coupling of the right pITG during each condition. We predicted that pITG - IPS coupling would be evident, even in kindergarten, when simply identifying a numeral (i.e. during classification), as well as when actively associating a numeral with its magnitude referent (i.e. during comparison). Across all task conditions, the pITG was strongly coupled to a bilateral frontoparietal network including the IPS. We assessed the predicted selectivity of this coupling by contrasting against control conditions involving letter and dot processing, from each task respectively. At the whole-brain level ($p<0.05$ corrected), we found no significant clusters for digit versus letter classification. For digit versus dot comparison, we found one cluster in the postcentral sulcus greater for dots. We found no evidence in this whole-brain, group-level analysis, that the pITG demonstrates numeral-selective coupling during either classification or comparison tasks in kindergarten. These results suggest that selective coupling emerges later in schooling, perhaps after children have had more experience using numerals in mathematical contexts.

Acknowledgements: This work was supported by the National Science Foundation (Division of Research On Learning) under Grant No. 1660816.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1710

Effects of perceptual and categorical novelty on construal level

Poster Presentation - *Topic area: Object Recognition: Categories*

Celia Durkin[1] (ced2166@columbia.edu), Zarrar Shehzad[1], Eric Kandel[1], Daphna Shohamy[1]; [1]Columbia University

How do different types of novelty create an abstract mindset? The idea that different cues elicit different levels of abstraction has been suggested by several theories. Construal Level Theory suggests we mentally represent (construe) events at different levels of abstraction based on psychological distance. Events and objects that are close in space and time elicit concrete representations while events and objects that are farther in space and time elicit more abstract representations. Novelty Categorization Theory suggests that when we encounter a novel stimulus, we adopt a more abstract mindset in order to integrate the new stimulus into existing knowledge structures. While novelty has been shown to increase construal and facilitate global processing, how different forms of novelty affect processing-level is unknown. We examine the effect of perceptual and categorical novelty on construal of art. Participants viewed a sequence of representational and abstract paintings and decided whether each would hang in a gallery opening tomorrow or in one year. To quantify perceptual-level novelty, we used similarity metrics from Matlab's Structural Similarity Index, a measure of low-level visual features. To quantify category-level novelty, we extracted the output layer of VGG16, a neural network trained on object recognition, and a measure of higher-level visual features. Finally, we obtained human pairwise comparisons. Using MDS, we transformed each of the metrics into three similarity spaces. We found that novelty type differentially affects construal. Paintings that were categorically novel (distant from the previous stimulus in VGG16 space) were more likely to hang in a gallery opening in one year, while there was no difference in construal for paintings that were perceptually novel (distant from the previous stimulus in SSIM space). These results suggest that perceptual vs. categorical novelty influence distance judgements differently and suggests that category-level novelty may be more effective at creating an abstract mindset.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1700

Expectations alter representations during object categorization

Poster Presentation - *Topic area: Object Recognition: Categories*

Laurent Caplette[1] (laurent.caplette@umontreal.ca), Frédéric Gosselin[1]; [1]Universite de Montreal

Prior expectations influence how we recognize objects. As suggested by recent evidence, this may be done by altering internal representations. However, how expectations of complex everyday objects affect representations remains largely unknown. Such objects are composed of multiple features that may be affected differently. For example, more generic low-spatial-frequency features could be represented when there are no specific expectations about the incoming object; when there is an expectation, subjects might focus on more specific high-spatial-frequency features to try to confirm their expectation. In the present study, subjects had to perform a 4AFC object categorization task. In the expectation condition, an object name was shown prior to the object image and indicated the most likely object to appear next (with 50% validity); in the no-expectation condition, a random string of letters appeared prior to the image. We randomly sampled spatial frequencies (SFs) across 400 ms on each trial. After reverse correlating accuracy with SFs shown at each moment for each condition, we observed that low SFs (~1-25 cycles/image) throughout recognition were significantly more used to categorize objects when there were no expectations than when there were valid expectations ($p < .05$), indicating that subjects focus on coarser features when they have no specific expectation. We further observed that there was significant variance in the use of high SFs (~35 cycles/image) late during recognition across object expectations ($p < .05$), indicating that subjects alter their representation in specific ways depending on their specific prior expectation. In summary, subjects focus on generic coarse features when they have no expectation, and they use fine features differently depending on the specific expectation. These results reveal the mechanisms underlying the effects of expectations on the recognition of real-world complex objects.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

You can email me at laurent.caplette@yale.edu for any question or to set up a Zoom meeting!

Check out my OHBM poster "Rhythmic sampling of visual features in the brain during object recognition": https://bit.ly/3dh7fxc
Our recent NeuroImage paper: https://bit.ly/2V1Dvhv

You can follow me on twitter: @laucaplette !

Abstract ID: 236

Faces boost animacy information in the human ventral temporal cortex

Poster Presentation - *Topic area: Object Recognition: Categories*

Daria Proklova[1], Mel Goodale[1]; [1]Brain and Mind Institute, Western University

Object animacy is an important organizing principle of the ventral temporal cortex (VTC) object representations, but the exact features driving this organization are still being investigated. Previous studies have shown that visual features such as overall body shape do not fully explain animacy information in VTC (Proklova et al, 2016, Bracci et al, 2016). However, inanimate objects such as toys or robots have recently been shown to be represented similarly to animals in VTC (Bracci et al., 2019; Contini et al., 2019), suggesting that this region might be sensitive to some diagnostic features that these objects share with animals, rather than animacy per se. One possible feature that has not been controlled for in previous studies is the presence of the face. Animate-like objects such as toys and robots often share this feature with animals, which could explain why they are represented similarly to animals in the VTC. In this study, we directly examined the role of faces in the animate/inanimate distinction in VTC representations using fMRI. To do this, we created a stimulus set in which animacy and face presence were orthogonalized. This stimulus set included images of faceless animals, animals with faces, and inanimate objects, organized into triplets based on an overall shape similarity. We performed representational similarity analysis (RSA) comparing the representational content of VTC with several models (animacy, face presence, visual similarity.) As expected, we observed significant correlation between neural dissimilarity in the VTC and the animacy model. Interestingly, this correlation was lower but still significant even after all animals with faces were removed from the analysis, showing that even animals without a distinct face were represented differently from inanimate objects in the VTC. Our results suggest that faces are important but not necessary feature for animate/inanimate distinction in the VTC.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1656

Mid-level feature differences support early EEG-decoding of animacy and object size distinctions

Poster Presentation - *Topic area: Object Recognition: Categories*

Ruosi Wang[1] (ruosiwang@g.harvard.edu), Daniel Janini[1], Aylin Kallmayer[2], Talia Konkle[1]; [1]Harvard University, [2]Goethe University Frankfurt

Human object-selective cortex shows a large-scale organization by the high-level properties of animacy and object size; but, this same neural organization is evoked when viewing “texform” stimuli, which are unrecognizable stimuli that preserve some texture and coarse form information from the original images (Long, Chen & Konkle, 2018). These results suggest the high-level categorical organization is driven largely by differences in mid-level feature tuning—the kind of features that would be detected early in visual processing. However, fMRI studies obscure timing information, and thus it is also possible that the animacy and object-size response differences to texforms were driven more by feedback and/or slower recurrent connections, perhaps reflecting automatic processes that impose higher-level interpretations of what the texforms might be, rather than mid-level feature tuning per se. In order to tease these possibilities apart, we measured neural responses over time using electroencephalography (EEG) and leveraged decoding analyses (n=17). We found successful animacy decoding for original as well as texform images, though to a weaker extent. Critically, this distinguishability between animals and object neural responses peaked at around the same time for texforms and original images (original: 186 ms, texform: 176 ms). Further, a classifier trained to decode animacy from neural responses to texforms could accurately classify neural responses to original images (cross-decoding: 176 ms). These results were also evident for size classification to a weaker degree (original: 156 ms, texform: 151 ms, cross-decoding: 152 ms). Taken together, these results demonstrate that mid-level featural differences underlie much of the neural responses that distinguish animals from objects or big from small things at an early processing stage. This work is in line with the idea that high-level animacy and object size properties in the visual system reflect responses tuned at a mid-level of representation available in an early feedforward pass of visual processing.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have any questions, please feel free to contact me at ruosiwang@g.harvard.edu.

Abstract ID: 738

Modality and category selectivity in the anterior temporal lobes

Poster Presentation - *Topic area: Object Recognition: Categories*

Andrew persichetti[1], Joseph Denning[1], Jiongjiong Yang[2], Stephen Gotts[1], Alex Martin[1]; [1]Laboratory of Brain and Cognition, NIMH/NIH, [2]Department of Brain and Cognitive Sciences, Peking University

The anterior temporal lobe (ATL) is a large and anatomically heterogeneous region of cortex with connections to memory, language, and perceptual systems. Given the connectivity profile of the ATL, different theories claim that it serves as a general convergence zone for all semantic information, while other models posit more selective roles in object recognition, language processing, and social cognition. To

investigate the functional roles of the ATL, we used a rapid event-related fMRI design to measure the responses across the ATL while 32 adults were asked to either name or categorize visual and auditory stimuli from two categories: common animals (e.g., dog, cat) and tools (e.g., hammer, saw). Each stimulus was represented in four ways: as a grayscale picture, a printed name, a spoken name, and a stimulus-associated sound. We analyzed the patterns of responses in functionally distinct cortical parcels within the ATL that were obtained using resting-state fMRI in a separate large cohort of adults (N=88). Within the most anterior portions of the ATL (i.e., the temporal pole), we found a bias toward visual stimuli in the medial and inferior temporal, and fusiform gyri. By contrast, we found a clear auditory bias in the superior temporal gyrus and sulcus. Within the visually selective portions of the temporal poles, we found a lateral bias towards animal pictures and a ventromedial bias towards tool pictures that is similar to the organization of more posterior category-selective cortex in the ventral visual stream. These results suggest that the temporal pole, and the ATL more generally, can be functionally dissociated into category- and modality-selective regions. Therefore, the ATL does not seem to be a domain-general semantic hub. Rather, it seems to comprise functionally distinct regions that are part of domain-specific cognitive systems.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 371

Mugs and Plants: Objects' Action Associations Bias Perception

Poster Presentation - *Topic area: Object Recognition: Categories*

Dick Dubbelde[1] (dubbelde@gwu.edu), Sarah Shomstein[1]; [1]The George Washington University

Neuroimaging studies of object recognition have revealed that object processing is largely a result of computations within the dorsal and ventral visual streams. Each stream is differentially recruited depending on object identity. Objects with strong action associations (e.g., tools) recruit dorsal regions more than non-tool objects, which are more reliant on ventral processing. We hypothesized that if this differential functional recruitment is indeed meaningful, it should have behavioral consequences. Due to the relative proportions of magno- and parvo-cellular input to each stream, processing along the dorsal stream, such as when a tool is seen, should have higher temporal sensitivity, while processing along the ventral stream, such as when a non-tool is seen, should have higher spatial sensitivity. We test this hypothesis using two tasks: gap detection, testing the spatial resolution of the ventral parvocellular processing, and object flicker discrimination, testing the temporal resolution of the dorsal magnocellular processing. Across several experiments we show (1) a non-tool advantage in spatial resolution, (2) a tool

advantage in temporal discrimination, (3) that this advantage is reduced by impeding object recognition through inversion, and (4) that this advantage diminishes when suppressing magnocellular processing with red light. Lastly, if these effects are due to expectation of object use, then the spatial and temporal resolution differences observed between tools and non-tools should be modulated by reachability. In virtual reality (VR), tools and non-tools are presented at variable depths, with the prediction that the perceptual differences should diminish with distance from the observer. These results demonstrate perceptual differences in object processing arising from differential recruitment of the two processing streams, such that tools, which recruit the more magnocellular dorsal stream regions have higher temporal resolution, and non-tools, which are reliant on the more parvocellular ventral stream regions, have higher spatial resolution.

Acknowledgements: This work was supported by NSF grants BCS-1534823 and BCS-1921415 to SS.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 153

Tool-selective lateral temporal cortex responds to objects with causal effects

Poster Presentation - *Topic area: Object Recognition: Categories*

Anna Leshinskaya[1] (anna.leshinskaya@gmail.com), Mira Bajaj[1], Sharon L. Thompson-Schill[1]; [1]University of Pennsylvania

Several cortical areas respond selectively to images of tools (e.g., hammers, paint-brushes) relative to other kinds of objects (e.g., clocks, shoes). What drives these responses? Tools have elongated shapes and are more likely to have motor associations, but an under-explored yet core property is that they exert causal effects on the environment. We hypothesized that tool-selective areas should respond to novel objects to the extent that these objects also exert causal effects. We used animations to imbue novel objects with causal properties by varying the temporal order of events: ‘causer’ objects moved before the appearance of an environmental event (e.g., stars appearing), while ‘reactor’ objects moved afterwards. Shapes were counterbalanced across conditions. In addition, the objects’ movements were either self-generated or initiated by an animated hand. Participants memorized the animations associated with each object, then viewed pictures of the objects during fMRI. In a separate localizer, responses to images of real-world tools

(e.g., hammers) were contrasted to non-tool objects (e.g., clocks) to identify tool-selective lateral temporal (LOTC) and inferior parietal (IPL) areas. The reverse contrast was used to identify a non-tool-selective parahippocampal (PHC) area. We found that tool-selective LOTC responded more to causers than reactors (both self- and hand- initiated), and this causality effect was significantly stronger than in non-tool-selective PHC. Effects were robust even in the most tool-selective LOTC voxels. No effects were found in IPL. We suggest that LOTC has a preference for objects with causal effects, and this preference can emerge as a result of learning about event relations involving those objects.

Acknowledgements: This work was supported by National Institutes of Health (P30 NS45839 to the Center for Functional Neuroimaging at the University of Pennsylvania, and R01DC015359, and R01DC009209 to S.L.T-S).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1417

Visual object categorization in infancy

Poster Presentation - *Topic area: Object Recognition: Categories*

Céline Spriet[1], Etienne Abassi[1], Jean-Rémy Hochmann[1], Liuba Papeo[1]; [1]Institut des Sciences Cognitives Marc Jeannerod, unité mixte de recherche (UMR) 5229, Centre National de la Recherche Scientifique (CNRS), Université de Lyon

How do infants see the world? The object is the unit of visual perception and attention. In the adult visual cortex, object representations are spatially organized by categories, with a broad distinction between animate and inanimate objects encompassing finer-grained distinctions between human vs. nonhuman faces and bodies, and natural vs. artificial big and small objects. While some cortical hallmarks of this organization seems to be already in place at birth, it remains unknown when that organization becomes functional so to drive infants' looking behavior. We studied this issue, with eye-tracking. We measured the differential looking time (DLT) as 4- and 19-month-olds looked at two exemplars belonging to two of the above eight categories. Using the DLTs, for each group, we built a representational dissimilarity matrix (RDM) evaluating infants' perceived similarity/dissimilarity of each stimulus pair. Using representational similarity analysis, we found that 4-month-olds showed an overall preference for human faces, while they discriminated all other objects based on the current size (number of pixels - Figure 1A). The broadest

animate-inanimate distinction emerged only when, in a second study, we controlled for the image size (Figure 1C). Instead, the RDM of 19-month-olds matched the mature visual cortex organization by categories. Confirming this, the RDM of 19-month-olds also correlated with object representation in the highest layers of the AlexNet Deep Neural Network (DNN), which provides a model of visual object recognition (Figure 1B). Thus, infants first prefer human faces, then form the broad categories of animate and inanimate objects (by the 4th month of life). The adult-like organization of visual-object representation is fully functional by the 19th month of life.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1079

Object Recognition: Deep neural networks

Approximate number representations emerge in object-trained convolutional neural networks and show human-like signatures of number discrimination

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Daniel Janini[1] (janinidp@gmail.com), Talia Konkle[1]; [1]Harvard University

What are the visual input analyzers that yield numerosity representations? Recent work from Nasr et al. (2019) provides an interesting possibility: numerosity representations are implemented by the same cortical networks that can classify objects. They found that a convolutional neural network trained on object classification had units with tuning curves for numerosity, similar to neurons in primate parietal and frontal cortex. Here, we extend these findings, examining whether the neural network’s number representations are tolerant to stimulus variation and show signatures of human number perception. We recorded responses to dot displays in each unit of AlexNet trained on 1000-way object classification. A subset of units in AlexNet had gaussian tuning curves for number, with wider tuning curves for higher preferred numerosities. Tuning curves were stable across stimulus sets controlling for surface area, density, convex hull, total circumference, and dot radius. Extending previous findings, we also observed that the tuning curves were even maintained in textured dot displays (for example, fur-textured dots on grass-textured background). These results were replicated in another architecture (VGG16) and critically were

not evident in an untrained network. Next, we tested whether AlexNet's number tuning was susceptible to grouping effects similar to the human visual system. Both humans and AlexNet underestimated the numerosity of displays with dots grouped into pairs relative to displays with randomly arranged dots. We also created images in which lines connected pairs of dots, decreasing the number of continuous objects. Like humans, AlexNet's number representations decreased as dots were connected. Altogether, these results indicate that neural networks trained on object recognition gain robust number representations. Moreover, these representations are influenced by spatial grouping and connectedness, matching properties of human behavior. These results support the view that the same input analyzers that untangle object categories from retinal input also yield approximate number representations.

Acknowledgements: Funding provided by National Defense Science and Engineering Graduate Fellowship

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

I have put the script from the video in this google doc:
https://docs.google.com/document/d/1HaBCchQxedmgdj1SP_j0QHu3aMuvpvMmHRhjGgSL178/edit?usp=sharing

If you have trouble accessing it email me at daniel_janini@g.harvard.edu.

Abstract ID: 1120

Comparing Word Recognition by Humans and Deep Neural Networks

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Elena Sizikova[1] (es5223@nyu.edu), Carol Long[1], Omkar Kumbhar[1], Najib Majaj[1], Denis Pelli[1]; [1]NYU

We compare word recognition by deep neural networks (DNN) and humans, asking whether the effects of increased pooling in the network can model crowding in human vision. We focus our experiments on a "Convolutional Recurrent Neural Network" CRNN [Shi et al. 2016], a popular model for word recognition. We study efficiency and crowding of the network on word recognition. To measure efficiency, we assess the network's performance in recognizing random 4-letter words in mono-space font at various contrast levels on a white noise background. We find that the network has a lower efficiency than the human observer: in our experiments, we found that the network has roughly one tenth of the 3\% efficiency that the humans attain[Pelli et al., 2003]. Letter crowding in human vision results in a minimum threshold spacing, independent of letter size. Crowding is usually explained as inappropriately large pooling for the

task at hand. We studied how the network's size and spacing thresholds would be affected by changing its pooling from 2 to 32. The network with modified pooling was trained as specified by the original authors. We measured word recognition accuracy as a function of letter size and spacing. For humans tested at any given eccentricity, there are two regimes, one limited by crowding, and one limited by acuity[Song et al. 2014]. In the crowding regime, the threshold size is inversely related to spacing ratio. In the spacing regime, the threshold is independent of the spacing ratio. In the network, our manipulation revealed only one regime for all pooling values: a slope of -0.3 for a log-log plot of acuity vs spacing ratio, unlike the human data, which has slopes of -1(crowding limited) and 0(acuity limited). Based on these results, we believe that there are important limitations in how well this network models human reading.

Acknowledgements: Moore Sloan Foundation, NIH grant R01 EY027964 to DGP

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1489

Conjunctive coding of color and shape in convolutional neural networks

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

JohnMark Taylor[1] (johnmarktaylor@g.harvard.edu), Yaoda Xu[2]; [1]Harvard University, [2]Yale University

Understanding how the visual system conjunctively codes color and shape has long fascinated cognitive psychologists, cognitive neuroscientists, and neurophysiologists. Recent developments in convolutional neural networks (CNNs) provide us with an excellent opportunity to examine how color and shape conjunctions may be encoded in artificial systems only trained to perform object recognition. To determine whether CNNs encode color and shape independently or in an interactive manner, we used representational similarity analysis to characterize the responses of Alexnet, VGG19, Cornet, Resnet, and Googlenet to different objects, each presented in several different colors. Regardless of the CNN examined, we found that whereas lower layers of the CNNs encode colors in a similar manner across different objects, in higher layers the color spaces associated with different objects are more distinct. The converse is also true: early layers encode shape in a more similar manner across colors than later layers. Interestingly, the similarity between the color spaces of different objects was only weakly (though significantly) associated

with the objects' shape similarity. These results held when color and shape similarity were equated, and when uniformly colored "silhouette" images were used instead of naturally textured images. These results demonstrate that rather than being encoded in an orthogonal manner, color and shape processing becomes increasingly interactive in higher layers of a CNN, suggesting that neural networks optimized for object recognition will naturally develop conjunctive coding of color and shape. These results will be compared with those from responses from visual regions in the human brain to test whether a similar conjunctive coding scheme exists in natural visual systems.

Acknowledgements: This work is supported by a National Science Foundation Graduate Research Fellowship (DGE1745303) to JohnMark Taylor

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 400

Controversial stimuli: adjudicating between deep neural network models of biological vision with synthetic images

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Tal Golan[1] (tal.golan@columbia.edu), Prashant C. Raju[1], Nikolaus Kriegeskorte[1]; [1]Columbia University

Deep neural networks (DNNs) provide the leading model of biological object recognition, but their power and flexibility come at a price: different DNN models often make very similar predictions. To enable iterative testing and improvement of DNNs as scientific hypotheses about biological vision, we need to efficiently adjudicate between different candidate models. Here, we suggest synthetizing controversial stimuli to achieve this aim. Controversial stimuli are inputs (e.g., images) whose classifications by two (or more) models are incompatible. Since human perceptual judgments of a controversial stimulus cannot be compatible with both models, such judgments are guaranteed to provide evidence against at least one of the models. Therefore, controversial stimuli allow to efficiently contrast the validity of different models. To demonstrate our approach, we have assembled a diverse set of nine models, all trained on MNIST, whose various solutions cannot all be good models of how humans recognize digits. For each pair of models, we

sampled random noise images and optimized them to increase the incompatibility of their classifications by the two models. This resulted in a stimulus set that induces disagreement among the models. We tested these stimuli on 30 human observers, who rated the presence of each of the ten digits from 0% to 100% in each image. Contrasting each model's outputs with the judgments of each observer revealed that the two generative models we tested, a shallow Gaussian kernel-density estimate and the deep VAE-based Analysis-by-Synthesis model, were considerably and significantly better at predicting the human responses than all the discriminative DNNs we tested. However, no model entirely explained the explainable variability of the human responses. We discuss controversial stimuli as an efficient experimental paradigm for comparing DNN models of vision and as a practical and conceptual generalization of adversarial examples.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Our preprint is available here: https://arxiv.org/abs/1911.09288
A zoomable image of our poster is available here: https://tinyurl.com/yafnu468

Please feel free to contact us with questions/comments at tal.golan@columbia.edu

Abstract ID: 947

Deep Neural Networks Point to Mid-level Complexity of Rodent Object Vision

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Kasper Vinken[1,2] (kasper.vinken@childrens.harvard.edu), Hans Op de Beeck[2]; [1]Harvard Medical School, [2]KU Leuven

In the last two decades rodents have been on the rise as a dominant model for visual neuroscience. This is particularly true for earlier levels of information processing, but high-profile papers using advanced behavioral paradigms have suggested that also higher levels of processing such as invariant object recognition occur in rodents. Nevertheless, it remains unknown whether and to what extent a further abstraction beyond primary visual cortex was required to perform these object recognition tasks. Here we provide a quantitative and comprehensive assessment of the claims of higher levels of processing by comparing a wide range of rodent behavioral and neural data with convolutional deep neural networks trained on object recognition. We find that data from earlier studies meant to probe high-level vision in

rodents can be explained by low to mid-level convolutional representations that fall short of the complexity of representations underlying object recognition in primates. For example, successful generalization to novel sizes and viewpoints of two rendered objects (Zoccolan et al., 2009) could already be captured by the first convolutional layer, but later layers explained more variance in stimulus-level performance patterns. On the other hand, later convolutional layers were required to capture generalization to novel natural video category exemplars (Vinken et al., 2014). Consistent with this finding, later convolutional layers matched the representational geometry increasingly better for extrastriate areas in the rat visual cortex. Our approach also reveals surprising insights on assumptions made before, for example, that the best performing animals would be the ones using the most complex representations (Djurdjevic et al., 2018) – which we show to likely be incorrect. Overall, our findings support a mid-level complexity of rodent object vision and suggest a road ahead for further studies aiming at quantifying and establishing the richness of representations underlying information processing in animal models at large.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 417

Deep Neural networks are “doing the categorization task,” but how?

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Christoph Daube[1] (c.daube.1@research.gla.ac.uk), Tian Xu, Jiayu Zhan, Andrew Webb, Robin A A Ince, Oliver G B Garrod, Philippe Schyns; [1]University of Glasgow

Deep neural networks (DNNs) are appealing as models of human vision because they categorize complex images with human-like performance — i.e. they “do the categorization task” with unprecedented accuracy. However, there is a considerable gap between doing the task with similar performance and doing it like the human brain, using similar stimulus representations. Thus, before evaluating the potential contribution of DNNs as models of the brain, we first need to ensure that they perform the same task with the same features (e.g. to categorize a happy face with its diagnostic mouth and wrinkled eyes). Here, we exploited the tight experimental control over such stimulus features afforded by an interpretable and realistic generative model of face information (GMF, SuppMatA), which generated 3.5M images with varying categorical factors (2,004 identities, 2 genders, 3 ages, 2 ethnicities and 7 expressions of emotion, and 3 vertical and horizontal angles of pose and illumination). We trained (> 99% accuracy) two ResNet10s to classify 2,004 identities across image variations (ResNetId) plus the multiple other factors of the GMF causing these variations (ResNetMulti). Following training, we reverse correlated the internal

representations of 4 familiar faces in humans and the ResNet models. All faithfully (and unfaithfully) represented the 4 identities using similar shape features (e.g. a forehead or chin, SuppMatC&D). However, face noise testing (i.e. GMF shape vs. texture noise, SuppMatB) revealed that ResNetId generalization behavior was hyposensitive to shape but hypersensitive to texture, whereas ResNetMulti was less extreme. These generalization biases were reflected in the hidden layers, as shown in a comprehensive analysis of activation variance in each layer up to decision (SuppMatE). In sum, we enhanced the understanding of how DNNs "do the task" by first establishing a similarity of decision features with humans, before tracing how the DNNs' layers represent the factors of the GMF.

Acknowledgements: This work was funded by a Multidisciplinary University Research Initiative/Engineering and Physical Sciences Research Council grant (USA, UK; 172046-01) awarded to PGS.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Questions? Comments?
Please do not hesitate to get in touch via christoph.daube@gmail.com.
Also, feel free to stay in touch with me on twitter, where I sometimes tweet as @realdaubman

Abstract ID: 1411

Deepnets do not need category supervision to predict visual system responses to objects

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Talia Konkle[1] (talia_konkle@harvard.edu), George Alvarez[1]; [1]Harvard University

Substantial progress has been made understanding the nature of the representations along the visual hierarchy by focusing on the goal of core object recognition. As evidence, many deep neural networks trained only to do object categorization develop internal representations that are closely aligned with primate cortical responses. However, these recognition-trained deepnets receive extensive supervision with millions of object category labels, unlike natural visual experience. Here we test the hypothesis that visual system responses may be better captured under a different, unsupervised goal—that is, to remember and uniquely represent everything it sees. To examine this possibility, we trained several models with a common base architecture (alexnet, resnet18, and corrnet), but with different tasks. Supervised models were trained on 1000-way object categorization. Unsupervised models were trained to maximize instance-level discrimination within a fixed size memory-bank (leveraging and extending Wu et al., 2018).

The size of the memory bank was varied in different models to have 128, 256, or 1000 dimensions. Human brain responses were measured with functional magnetic resonance imaging (n=10), to a set of 72 inanimate object images, and we calculated the similarity structure evident in both the responses of object-selective cortex and all deepnet model layers. Overall we observed that human object-selective cortex responses were equal to or better captured by the unsupervised instance-level deep nets than the supervised categorization deep nets, particularly in the later representational stages. These results were robust across memory-bank sizes and base network architectures. These data provide the first evidence to our knowledge that unsupervised networks can fit brains better than matched supervised networks. Further, these data provide computational support for the broader hypothesis that the visual system's goal may be better conceptualized as providing unique, compressed descriptions of the visual world.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 498

Finding meaning in simple sketches: How do humans and deep networks compare?

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Kushin Mukherjee[1] (kmukherjee2@wisc.edu), Timothy T. Rogers[1]; [1]University of Wisconsin-Madison

Picasso famously showed that a single unbroken line, curved and angled just so, can depict a dog, penguin, or camel for the human viewer. What accounts for the ability to discern meaning in such abstract stimuli? Deep convolutional image classifiers suggest one possibility: perhaps the visual system, in learning to recognize real objects, acquires features sufficiently flexible to capture meaningful structure from much simpler figures. Despite training only on color photographs of real objects, such models can recognize simple sketches at human levels of performance (Fan, Yamins, & Turk-Browne, 2018). We consider whether the internal representations arising in such a model can explain the perceptual similarities people discern in sketches of common items. Using a triadic comparison task, we crowdsourced similarity judgments for 128 sketches drawn from 4 categories—birds, cars, chairs, and dogs (Mukherjee, Hawkins, & Fan, 2019). On each trial, participants decided which of two sketches was most perceptually similar to a third. From thousands of judgments we computed low-dimensional nonmetric embeddings, then compared these human-derived embeddings to representational structures extracted for the same sketches from the

deepest fully-connected layer of the VGG-19 image classifier. VGG-19 representations predicted human triadic comparison judgments with 59% accuracy--reliably better than chance, but still quite poor given chance performance of 50%. Embeddings derived from human judgments predicted held-out judgments with 75% accuracy. 2D embeddings derived from VGG-19 vs triadic-comparison differed starkly, with semantic category structure dominating the human-derived embedding and only weakly discernable in network representations. And yet network representations reliably captured some semantic elements: latent components predicted whether a given sketch depicted a living or non-living thing with 90% accuracy. Thus while the visual features extracted by VGG-19 discern some semantic structure in sketches, they provide only a limited account of the human ability to find meaning in abstract visual stimuli.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Follow me on twitter @kushin_m and reach out at kmukherjee2@wisc.edu

Abstract ID: 1026

Is Rodent Visual Cortex Really Just a Randomly Initialized Neural Network?

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Colin Conwell[1] (conwell@g.harvard.edu), George Alvarez[1]; [1]Harvard University

Image-recognizing deep neural networks now provide the gold standard for the modeling of primate visual cortex, predicting aggregate and individual neural profiles to striking accuracy. Their success in the modeling of rodent visual cortex, on the other hand, has been a bit more meted. Recent findings (Cadena & Others, 2019) have suggested that randomly initialized networks (never trained) provide about as predictive a set of features as the same networks when trained on image recognition, calling into question the use of such networks for the modeling of markedly different brains. We re-examine this finding with a methodology consisting of three components: one) the Allen Institute Brain Observatory two-photon calcium-imaging visual coding dataset (de Vries & Others, 2018); two) a battery of 11 ImageNet-pretrained architectures; and three) a cross-validated nonlinear least squares regression analysis in which we iteratively build a predicted representational dissimilarity matrix from across all features of each model for a given neural site and compare it to the actual representational dissimilarity matrix calculated on the images used by the Allen Institute. Contrary to previous findings, we find that ImageNet-pretrained models almost categorically outperform their randomly initialized counterparts by a large margin (Student's t(460)

= 7.3, p = 1.25e-12, Cohen's d = .78). However, even the most performant model (SqueezeNet, with mean R2 of 0.116 +|- 0.075 SD) falls far short of the ceiling suggested by the split-half reliability of the neural data (with mean R2 of 0.58 +|- 0.252 SD), suggesting there remains room for substantial innovation in the engineering of both model architectures and training task. More broadly, it deepens the ongoing mystery of how exactly standard neural networks can serve as the model for the rich diversity (and fiendish complexity) of biological brains at scale – even when that scale is the size of a mouse.

Acknowledgements: Many thanks to Dr. Michael Buice (Allen Institute) for assistance in preparing the visual coding dataset and to Dr. Andrei Barbu (Massachusetts Institute of Technology) for suggestions.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 968

Unintended cue learning: Lessons for deep learning from experimental psychology

Poster Presentation - *Topic area: Object Recognition: Deep neural networks*

Robert Geirhos[1,2] (robert.geirhos@uni-tuebingen.de), Jörn-Henrik Jacobsen[3], Claudio Michaelis[1,2], Richard Zemel[3], Wieland Brendel[1], Matthias Bethge[1], Felix A. Wichmann[1]; [1]University of Tuebingen, [2]International Max Planck Research School for Intelligent Systems, [3]University of Toronto, Vector Institute

Recently, Deep Neural Networks (DNNs) have become a major tool and model in vision science. However, DNNs often fail unexpectedly. For example, they are highly vulnerable to noise and struggle to transfer their performance from the lab to the real world. In experimental psychology, unexpected failures are often the consequence of unintended cue learning. For example, rats trained to perform a colour discrimination experiment may appear to have learned the task but fail unexpectedly once the odour of the colour paint is controlled for, revealing that they exploited an unintended cue---smell---to solve what was intended to be a vision experiment. Here we ask whether unexpected failures of DNNs too may be caused by unintended cue learning. We demonstrate that DNNs are indeed highly prone to picking up on subtle unintended cues: neural networks love to cheat. For instance, in a simple classification paradigm with two equally predictive cues, object silhouette and object location, human observers unanimously relied on object silhouette whereas DNNs used object location, a strategy which fails once an object appears at a different location. Drawing parallels to other recent findings, we show that a wide variety of DNN failures

can be understood as a consequence of unintended cue learning: their over-reliance on object background and context, adversarial examples, and a number of stunning generalisation errors. The perspective of unintended cue learning unifies some of the key challenges for DNNs as useful models of the human visual system. Drawing inspiration from experimental psychology (with its years of expertise in identifying unintended cues), we argue that we will need to exercise great care before attributing high-level abilities like "object recognition" or "scene understanding" to machines. Taken together, this opens up an opportunity for the vision sciences to contribute towards a better and more cautionary understanding of deep learning.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

Thanks for stopping by! Please feel free to reach out via chat and/or Email (robert.geirhos@uni-tuebingen.de).

A preprint of this work is available here: https://arxiv.org/abs/2004.07780
Cheers, Robert

Abstract ID: 652

Object Recognition: Features

A principled approach to the detection of camouflaged objects

Poster Presentation - *Topic area: Object Recognition: Features*

Abhranil Das[1] (abhranil@abhranil.net), Wilson Geisler[1]; [1]University of Texas at Austin

Camouflage must be appreciated as an extraordinary feat of evolution, but any detection of such camouflaged objects by predator and prey is also an impressive feat of visual systems. Many historical studies of camouflage have focused on descriptive compilations or heuristic applications. Our goal instead is to understand camouflage detection in the framework of controlled psychophysical experiments, and to develop a principled theory based on task-relevant stimulus statistics and known biological vision mechanisms. Moreover, unlike most object detection questions in computer science and psychology that utilize multiple cues, we focus on the particularly hard scenario where the camouflaging object exactly mimics the luminance, contrast, color and texture of its background. What then is the available

information, and how does the visual system exploit it? We recognize that most of the information here resides at the object-background edge. We define measures to quantify the total magnitude and spatial distribution of this edge information, calculate them at multiple spatial scales in accordance with known early visual computations, and develop a method to condense these correlated cues into fewer dimensions. We also describe a whitening procedure that decorrelates the texture and losslessly gathers the distributed cues into a narrow object boundary. In parallel, we characterize human psychophysical detection performance on stimuli with pink noise texture (which is well-studied and shares properties of natural scenes, hence provides a principled starting point), then extend to more naturalistic textures. We find that the edge measure that we have developed predicts detection performance smoothly, allowing us to extract detection thresholds across differing conditions of luminance, contrast, target size and stimulus duration. We apply these findings to identify the best location for an object to hide against a background, and evaluate the effectiveness of different textures for camouflage.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 580

Ensemble representation of objects with multiple features is based on conjoint representation of individual feature ensembles

Poster Presentation - *Topic area: Object Recognition: Features*

Jihong Lee[1] (stellamea@yonsei.ac.kr), Sang Wook Hong[2], Sang Chul Chong[1,3]; [1]Graduate Program in Cognitive Science, Yonsei University, [2]Department of Psychology, College of Science, Florida Atlantic University, [3]Department of Psychology, Yonsei University

Extracting summary statistics is an efficient strategy coping with a complex visual scene. In the world, multiple objects usually vary along multiple features. However, there are not many studies investigating how people represent a multi-feature ensemble. Here, we conducted membership identification tasks on objects with two features. A display set consisted of 8 circles whose color and size varied in a consistent manner (correlation coefficient r = 1: e.g., as the size of the circle increased, its color varied from blue to green) or in a random manner (r = 0) to examine whether the inter-feature correlation influences representing features conjointly. Following the display set presentation, participants judged whether a probe was the member or not. In Experiment 1, we tested with probes whose conjoined features varied.

When the probe was new, two features were outside the displayed range (outlier), were the mean of displayed set (mean), or had the opposite relationship to that of the displayed set (inversely-correlated). Participants accurately recognized members, rejected outliers, and falsely recognized means as often as members regardless of the display set correlation. For inversely-correlated probes, false positives were at the same level as members when r = 0 but were reduced when r = 1. In Experiment 2, we tested with single-feature probes (color or size). Participants falsely recognized means but rejected outliers less compared to conjunction probes. In addition, the feature type and the correlation condition had little effect. In Experiment 3, the new probe had conjoined features, one of which was fixed to the mean, and the other was located either within (mean-interior) or outside the displayed range (mean-exterior). Participants correctly rejected mean-exteriors regardless of the correlation, whereas they hardly rejected mean-interiors. Overall, our results suggest that for multi-feature ensembles, people represent statistical properties of each feature and use them conjointly.

Acknowledgements: This research was supported by the Brain Research Program of the National Research Foundation (NRF) funded by the Korean government (MSIT) (NRF-2017M3C7A1029658).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 625

Localizing feature- and conjunction-coding in the ventral visual pathway for objects and scenes

Poster Presentation - *Topic area: Object Recognition: Features*

D. Merika W. Sanders[1] (dmerikawilso@umass.edu), Rosemary A. Cowell[1]; [1]University of Massachusetts Amherst

The hierarchical organization of stimulus representations in the ventral visual stream is well documented by findings from electrophysiology in animals and neuroimaging in humans. We have long known that feature-coding (representing low-level image properties) is dominant early in the ventral visual stream, whereas conjunction-coding (representing object-parts and objects) is dominant in later ventral visual stream areas. A recent study confirmed and localized the existence of a transition from feature- to conjunction-coding (i.e., the point at which neural representations become less informative about individual features and more informative about the conjunction of those features) for simple object stimuli. Here, we extend these

findings to more complex stimulus sets, testing two central assumptions of the representational-hierarchical account of cognition: (1) that the transition from feature-coding to conjunction-coding extends into anterior ventral visual stream and medial temporal lobe, and (2) that the location of the transition depends on the complexity of the stimuli. Participants in the scanner performed 1-back repetition-detection while viewing two stimulus sets with different levels of complexity: fribbles (novel 3D objects) and scenes (novel, computer-generated rooms). Each unique stimulus was composed of three simple, binary features; by using all possible combinations of the three features we created a “family” of stimuli in which items shared many features but were each defined by a unique conjunction. A multivariate analysis of functional imaging data designed to reveal dominance of feature-coding vs. conjunction-coding for these stimuli revealed that the transition from feature- to conjunction coding was located further posterior in the ventral visual stream for objects than for scenes. This confirms the existence of a continuum of representations for complex stimuli, and suggests that the location of “conjunction” representations in the brain depends on the complexity of the conjunction.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1453

Motion-defined object category responses in the human brain

Poster Presentation - *Topic area: Object Recognition: Features*

Sophia Robert[1] (sophia.robert@nih.gov), Leslie Ungerleider[1], Maryam Vaziri-Pashkam[1]; [1]Laboratory of Brain and Cognition, National Institute of Mental Health, National Institutes of Health

Humans can label and categorize objects in a visual scene with high accuracy and speed—a capacity well-characterized with neuroimaging studies using static images. However, in a dynamically moving visual scene, motion is another cue that could be used by the visual system to classify objects. To determine how motion-defined object category information is processed in the brain, we created a novel stimulus set to isolate motion-defined signals from other sources of information. We used videos of 6 object categories, extracted their movement information, and applied the extracted motion to random dot patterns to create motion-defined stimuli. We first ran a behavioral categorization task with these stimuli and found that humans can accurately categorize the objects based on just their motion, without access to luminance-defined form. We then investigated whether fMRI responses elicited by motion cues could be decoded at the object category level in functionally defined regions of occipitotemporal and parietal cortex. In a block design, participants performed a one-back repetition detection task as they viewed three second

presentations of either motion-defined stimuli or static images cropped from random frames of the original videos. Using linear classifiers, we were able to significantly decode object category in both stimulus formats in all functionally-defined regions, including lateral occipital cortex, extrastriate body area, posterior fusiform sulcus (pFS), and inferior intraparietal sulcus. Classification accuracies were similar across the two conditions in all regions except pFS, which had significantly higher classification accuracy in the image condition. Significantly above chance classification accuracies in all regions were also observed when training the SVM classifier on data from the motion-defined condition and testing it on the image condition and vice versa. These results demonstrate that motion-defined cues can elicit robust category responses on par with those elicited by luminance cues in regions of object-selective visual cortex.

Acknowledgements: This project was supported by the NIMH intramural research program.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1247

Restoration of categorical spatial relations explains the facilitated recognition of inverted objects

Poster Presentation - *Topic area: Object Recognition: Features*

Charles Peasley[1] (cpeasley@iastate.edu), Eric Cooper[1]; [1]Iowa State University

An extremely well replicated patterning in picture-plane rotation object recognition time functions is a dip from about 135° to 225° that reaches a local minimum at 180°. Two experiments were conducted to determine why there is a counter-intuitive local improvement in recognition performance when object images are inverted. Experiment 1 used naturally occurring, everyday objects in a vocal identification task to assess the effects of picture-plane rotation (either 0°, 90°, 180°, or 270°) on reaction times and error rates. Stimuli were selected strategically and presented one at a time. Performance varied according to the spatial configuration of an object's visual features. Objects with only side-of part relations evinced the characteristic M-shaped rotation function, with planned contrasts for reaction times and error rates revealing the dip at 180°. In contrast, for objects with an above-below spatial organization of parts, recognition functions demonstrate a positive monotonic relationship between identification difficulty and deviation from the canonical orientation (i.e., 0°). Planned contrasts for reaction times and error rates

revealed a peak at 180° in the rotation functions for the above-below objects. Experiment 2 employed a brief-exposure sequential matching paradigm (same or different task) and a novel set of artificial objects displayed at one of the four aforementioned rotations to control for previous exposures and potential extraneous variables associated with naming naturally occurring objects. Again, planned contrasts revealed that rotation functions critically depend on the type of categorical relationship between the visual features of an object. The dip only occurred for inverted side-of objects and not for inverted above-below objects. Together, these experiments suggest that the restoration of categorical spatial relations upon picture-plane inversion facilitates recognition performance and that basic-level object structural representations are encoded to generalize to mirror reflections in the lateral plane which preserve canonical above-below relations.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1800

The Primacy of Color in Visual Perception

Poster Presentation - *Topic area: Object Recognition: Features*

Marjan Persuh[1] (mpersuh@bmcc.cuny.edu), Brian Zhang[1]; [1]BMCC, CUNY

The phenomenon of change blindness suggests that visual experience is sparse and limited by attention and working memory capacity. Iconic memory experiments, however, suggest that our visual experience is rich and that we are aware of many details of our environment. To circumvent the involvement of memory, we developed a methodology that directly measures the richness of visual experience without reliance on memory. A circular array of either color patches, geometric objects or different orientations, with set sizes of two, five or eight, was briefly displayed to participants. On half of the trials, one of the randomly selected items was present twice and participants were asked to report repetition. Because the repeated item was not known in advance, the task estimated the content of perceptual experience. With a set size of two, performance was at ceiling for all features; however, with a set size of five, accuracy for color was significantly different from both orientation and shape. With a set size of eight, accuracy for color remained high, whereas accuracies for other features dropped to chance levels. We further explored perception of color in a second experiment by increasing the number of simultaneously presented items to sixteen. Accuracy was above chance even for a set size of twelve and only dropped to chancel level when sixteen colors were displayed. Our results demonstrate that the richness of visual experience depends on specific features and that our perception of color is superior to our perception of orientation and shape.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1360

Object Recognition: Learning, deep neural networks

Do noise-trained DNNs process noisy visual images in a more human-like manner?

Talk Presentation - *Topic area: Object Recognition: Learning, deep neural networks*

Hojin Jang[1,2] (hojin.jang@vanderbilt.edu), Frank Tong[1,2]; [1]Vanderbilt University, [2]Vanderbilt Vision Research Center

Previously, we have shown that DNNs that have been trained to recognize objects in extreme levels of visual noise can attain performance levels that match human observers (Jang & Tong, VSS, 2018). However, is it necessarily the case that these noise-trained DNNs are processing visual information in a more human-like manner? We evaluated this question in 4 ways. First, we asked whether the critical signal-to-signal-plus-noise threshold, at which individual images of objects become recognizable, might be better correlated across noise-trained DNNs and human observers. Second, we asked whether extended training at recognizing objects in visual noise, such as animals vs. vehicles, would lead to category-specific or generalized benefits of learning for humans and DNNs. Third, we evaluated whether noise-trained DNNs rely on common diagnostic regions as human observers to recognize individual object images in noise. Fourth, we tested whether noise-trained DNNs can recognize objects in real-world noisy viewing conditions, such as rain or snow, given that human observers excel at such challenging tasks. We performed two behavioral learning experiments with human participants, in which they were trained by ImageNet validation dataset with noise, one on full 16 categories and the other on a subset of the 16 categories (i.e., either 8 animate or 8 inanimate categories). As a result, noise-trained DNNs showed more similar patterns of signal-to-signal-plus-noise thresholds to those of human observers. From the second experiment, human observers and noise-trained DNNs both failed to generalize to untrained categories with noise, indicating noise training is category-specific. Furthermore, noise-trained DNNs relied on more similar regions-of-interest with humans when recognizing objects in noise. Lastly, noise-trained DNNs significantly outperformed pretrained DNNs given real-world noisy images. To conclude, our results support the notion that noised-trained DNNs process noisy object images in a more human-like manner.

Acknowledgements: This research was supported by an NIH R01EY029278 grant to FT and P30EY008126 to the Vanderbilt Vision Research Center.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York

Presenter's Message

If you have any questions or comments, please feel free to contact me via email (hojin.jang@vanderbilt.edu).

Abstract ID: 1776

Exploring the effects of linguistic labels on learned visual representations using convolutional neural networks

Talk Presentation - *Topic area: Object Recognition: Learning, deep neural networks*

Seoyoung Ahn[1] (seoyoung.ahn@stonybrook.edu), Gregory Zelinsky[1], Gary Lupyan[2]; [1]Stony Brook University, [2]University of Wisconsin-Madison

Deep convolutional neural networks (CNNs) trained on large numbers of images are now capable of human-level visual recognition in some domains (Rawat and Wang, 2017). Analyses of the visual representations learned by CNNs show some resemblance to human visual representations (Kriegeskorte and Douglas, 2018), suggesting that these networks may offer a good model of human object recognition. Here, we use CNNs as a model of visual recognition for the purpose of exploring the effects of different types of labels on learning of visual categories. To what extent are labels necessary to distinguish between different kinds of tools, animals, and foods? One idea is that certain visual categories are so distinct that no guidance from labels is necessary. Alternatively, labels may help or even be necessary to discover certain types of categories. This question is difficult to answer in human learners because we cannot control their prior visual and semantic experience. We trained multiple CNNs on the same set of images while manipulating the labels they receive: none, basic-level labels (dog, hummingbird, hammer, van), superordinate labels (mammal, bird, tool, vehicle), or various combinations. We then correlated the model's choices on a triad task (given three images, select the one that is most different) with people's choices. The performance of unsupervised models was strongly dependent on low-level visual differences, highlighting the importance of labels to the training process. More surprisingly, the best performance was achieved by models trained using the coarser-grained superordinate labels (vehicle, tool, etc.) rather than basic-level labels, even when predicting triads where all three objects came from the same or from different superordinate categories (e.g., banana, a bee, and a screwdriver). The benefits of training with

superordinate-level labels will be further discussed in the context of representational efficiency and generalizability.

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 612

Individual Differences in Font Preference & Effectiveness as Applied to Interlude Reading in the Digital Age

Talk Presentation - *Topic area: Object Recognition: Learning, deep neural networks*

Shaun Wallace[1] (shaun_wallace@brown.edu), Rick Treitman[2], Nirmal Kumawat[2], Kathleen Arpin[3], Jeff Huang[1], Ben Sawyer[4], Zoya Bylinskii[2]; [1]Brown University, [2]Adobe Inc., [3]Riverdale Country Schoo, [4]University of Central Florida

In the age of pervasive reading on digital devices, incredible opportunities for customized interfaces abound. We consider how personalizing body text font can improve reading outcomes for adult readers. We present results of large-scale Interlude Reading experiments run on 386 crowdsourced participants, whereby we tested 16 body text fonts and measured impacts on font preference and reading speed. We define "Interlude Reading," nestled between glanceable and long-form reading, as the form of reading that occurs in short interludes and is common in the mobile context. Our studies controlled for participants' interest and familiarity with reading passages, familiarity with font families, and font size - via a perceptually-based font size normalization technique. While past work has considered how these factors affect reading in isolation, we present the first study that combines these factors under a single experimental methodology. First, our results show that normalizing a font's size affects reading speed and font preferences. Second, familiarity with a font predicts neither preference nor effectiveness of a font. Third, people do not know what is good for them: despite 80% of people believing their most preferred font would be their most effective for reading, this was only true 18% of the time. Fourth, and most surprisingly, a simple change in font yielded a reading speed gain of 38 words per minute on average, and 93 WPM for our top quartile of participants (equivalent to eight pages an hour) while comprehension remained similarly high. With these results, we put forward (1) a methodology for running large-scale

controlled reading studies, (2) a computational toolkit of crowdsourcing experiments, and (3) a list of concrete recommendations about favorable and effective fonts, and font normalization strategies. Moreover, the potential impacts on individual reading efficacy highlighted here demonstrate a need to further exploit the personalization of text formats.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for your interest in our talk. After the talk, we will hang around in the zoom room for anyone interested in chatting about the current state of the research or future collaborations.

Abstract ID: 412

Which “shoe” is best? Humans know what good training examples look like

Talk Presentation - *Topic area: Object Recognition: Learning, deep neural networks*

Makaela Nartker[1] (makaelanartker@gmail.com), Michael Lepori[1], Chaz Firestone[1]; [1]Johns Hopkins University

In order to recognize something as belonging to a category (e.g., to represent something as a dog, or a shoe), one must first see examples of that category (e.g., specific dogs, or specific shoes). Which examples teach best? This is a problem we routinely investigate as vision researchers — e.g., when studying category learning or perceptual expertise. But it is also one we confront as people interacting with others — e.g., when we teach peers, pets, or children what things look like. This raises an intriguing question: Do ordinary people know what makes a good training example? Here, we exploit machine recognition to ask whether naive subjects have accurate intuitions about which examples are best for learning new visual categories. We told subjects about a “robot” and asked them to teach it to recognize the numbers 1, 2, and 3. Subjects saw handwritten digits from the MNIST database, and selected the digits they thought would be best for learning those categories. We then trained a classifier on subjects’ choices, and discovered that subject-chosen examples produced higher classification accuracy (on an independent test-set) than examples that subjects rejected. Follow-up experiments showed that subjects were sensitive to differences that were salient to our classifier. When the difference in classifier performance on two sets was small, subjects had trouble choosing the better set; but when that difference was large, subjects consistently chose the better set. Moreover, these effects generalized beyond digits, to images of real objects: For example, subjects also successfully chose which sneakers and boots would best teach a classifier to recognize those objects. These

results reveal that people have surprisingly accurate intuitions for how others learn what the world looks like, and suggest a novel way to use "machine minds" to study human minds.

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1318

Object Recognition: Models and mechanisms

Hemifield-hemisphere interaction for visual recognition of words and faces in ventral occipitotemporal cortex

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Zhiheng Zhou[1,2] (zhhzhou@ucdavis.edu), Lars Strother[2]; [1]University of California Davis, [2]University of Nevada Reno

Visual recognition of words and faces is associated with oppositely lateralized neural mechanisms in the ventral occipitotemporal cortex (VOTC). We used fMRI multivariate pattern analysis to investigate the relationship between neural discriminability of word and face exemplars (i.e., within-category decoding) in VOTC and stimulus location. We also used univariate fMRI analyses and a behavioral task to demonstrate an expected opposite hemifield-hemisphere relationship and to further corroborate results from our multivariate fMRI analyses. As expected, observers who showed a right visual field (RVF) advantage for word recognition and a left visual field (LVF) advantage for face recognition also showed opposite cerebral lateralization for the two stimulus classes. For centrally-viewed stimuli, lateralized multivariate fMRI results were primarily limited to oppositely lateralized areas associated with word recognition and face recognition—a visual word form area (VWFA) in the left hemisphere and a fusiform face area (FFA) in the right hemisphere, respectively—and posterior fusiform (pFus) cortex on the same side for each. When words were viewed in the RVF, within-category decoding was limited to the VWFA (decoding in left pFus was no longer observed). When faces were viewed in the LVF, within-category decoding was limited to the

FFA (decoding in right pFus was no longer observed). In contrast, when words and faces were viewed in the non-preferred location (i.e., LVF for words and RVF for faces), neither VWFA nor FFA in both hemispheres showed successful within-category decoding. However, bilateral pFus showed successful within-category decoding in both cases. Our results suggest that opposite visual field advantages for word and face recognition have a neural basis in VOTC. Compromised recognition performance in the visual field locations ipsilateral to known category selective areas (VWFA and FFA) may reflect a shift from category-specific visual processing to domain-general visual processing of object information in more posterior visual cortex.

Acknowledgements: The research was supported by National Institute of General Medical Sciences of the National Institutes of Health under grant number P20 GM103650.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1363

How big should this object be? Perceptual influences on viewing-size preferences

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Yi-Chia Chen[1] (yi-chia.chen@fas.harvard.edu), Arturo Deza[1], Talia Konkle[1]; [1]Harvard University

When viewing objects depicted in a frame, most of us prefer to view large objects like sofas in larger sizes and smaller objects like paperclips in smaller sizes. In general, the visual size of an object that "looks best" is linked to its typical physical size in the world (Konkle & Oliva, 2011). Why is this the case? One intuitive possibility is that these preferences are driven by semantic knowledge: For example, we recognize a sofa, we access our knowledge about its real-world size, and this influences what size we prefer to view the sofa in a frame. However, might visual processing play a role in this phenomenon—that is, do visual features that are related to big and small objects look better at big and small visual sizes, respectively, even when observers do not have explicit access to semantic knowledge about the objects? To test this possibility, we used a kind of stimuli called "texforms" (Long et al., 2018), which are synthesized images that retain mid-level visual features related to the texture and coarse form information of the original images, but are unrecognizable at the basic-level. We used a two-interval forced choice task, in which each texform was presented at the canonical visual size of its corresponding original image, and a visual size slightly bigger or smaller. 12 out of 15 observers consistently selected the texform in the canonical visual size as the more

visually pleasing one above chance (61.8%, SEM=2.7%). This result suggests that the preferred visual size of an object depends not only on explicit knowledge of its real-world size, but also can be evoked by mid-level visual features that systematically covary with an object's real-world size.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

====== Comments? ======
Got thoughts to share or just want to chat like we'd do in-person?
Email "yichiachen @ ucla.edu" !

====== Texforms ======
For texforms details & generation code:
http://arturodeza.wdfiles.com/local--files/files/poster_Texforms.pdf
https://github.com/ArturoDeza/Fast-Texforms

====== My Website ======
For more of my research & online research-related resource:
https://ycc.vision

Abstract ID: 428

Idiosyncratic Visual Spatial Distortions Affect Object Appearances

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Zixuan Wang[1] (zixuan@berkeley.edu), Yuki Murai[1,2,3], David Whitney[1]; [1]Department of Psychology, University of California, Berkeley, [2]Japan Society for the Promotion of Science, [3]Graduate School of Frontier Biosciences, Osaka University

Perceiving the positions of objects is a prerequisite for most other visual and visuomotor functions. Although stable, consistent, and accurate localization is frequently assumed to be a simple product of retinotopic position, a recent study found that each individual observer mislocalizes the positions of briefly presented objects throughout the visual field in a unique way (Kosovicheva & Whitney, 2017). Within each observer, some regions of the visual field are effectively compressed and other regions are expanded. Previous work demonstrated that these regions of compression and expansion are closely associated with

higher spatial acuity and lower spatial acuity, respectively. This suggests that heterogeneous spatial resolution across the visual field might be the underlying mechanism of these individualized distortion fingerprints of position perception (Wang, Murai, Whitney, VSS, 2019; in prep). Are these biases caused by astigmatism and are they inherited along the visual hierarchy such that they change object appearance? Here, we show that the idiosyncratic biases are not due to astigmatism, since previous research revealed that individuals have distinct axes of astigmatism in their two eyes (McKendrick & Brennan, 1997), but our results demonstrated that the distortion fingerprints remained consistent when stimuli were viewed in either eye or binocularly. However, we did find that individualized spatial distortion biases modulate perceived object size. Using the method of single stimuli, we measured the perceived size of a briefly presented arc. The apparent size of the arc was associated with idiosyncratic visual space distortion patterns: Objects were perceived to be larger at perceptually compressed locations and smaller at expanded areas. Together, our study suggests that idiosyncratic spatial distortions induced by heterogeneous spatial acuity can influence visual appearance of object size or shape.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

Hi everybody, thank you for your interest in our work. Please feel free to refer to this preprint: https://www.biorxiv.org/content/10.1101/2020.06.09.143081v1 for more details. Our work got accepted in Proceedings of the Royal Society B: Biological Sciences.
Please also feel free to refer to my twitter account and I will tweet the paper once it is officially out (@ZixuanW39131799)!

Abstract ID: 592

Learning from few examples: Classifying sex from retinal images

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Aaron Berk[1] (aberk@math.ubc.ca), Gulcenur Ozturan[2], David Maberley[1], Özgür Yılmaz[1], Ipek Oruc[1];
[1]University of British Columbia, [2]Istanbul Okmeydanı Training and Research Hospital

Deep learning (DL) techniques have seen tremendous interest in medical imaging, particularly in the use of convolutional neural networks (CNNs) for the development of automated diagnostic tools. The facility of its non-invasive acquisition makes retinal fundus imaging particularly amenable to such automated approaches. Recent work in the analysis of fundus images using CNNs relies on access to massive datasets

for training and validation, composed of hundreds of thousands of images. However, data residency and data privacy restrictions stymie the applicability of this approach in medical settings where patient confidentiality is a mandate. Here, we showcase preliminary results for the performance of DL on small datasets to classify patient sex from fundus images — a trait thought not to be present or quantifiable in fundus images until recently. Specifically, we fine-tune a Resnet-152 model whose last layer has been modified to a fully-connected layer for two-class classification. We use stochastic gradient descent to train the model on 1706 retinal fundus images from 853 patients of known sex. We report a test error of 65% on the trained model and area under the curve of the receiving operator characteristic of 0.668. In addition, we analyze ensembles of such neural networks, examining how both ensembling method and the number of models in the ensemble impact classification performance. These results highlight usability and feasibility of DL methods when data is a limiting factor for automated analysis, and suggest a simple pipeline available to non-expert practitioners of DL.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 255

Low-level features, view tuning, and mirror symmetry: A parsimonious model accounts for commonalities and inconsistencies across neuroimaging studies

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Cambria Revsine[1] (revsinecl@nih.gov), Elisha P. Merriam[1], Fernando M. Ramírez[1]; [1]Laboratory of Brain and Cognition, NIMH

A growing body of neuroscience research focuses on linking computational models and measurements of neural activity. One such line of research centers on visual face recognition. A number of neuroimaging studies have reported mirror-symmetric tuning in human face-selective areas, in line with single-neuron observations in the macaque anterior-lateral face patch. Overall, however, studies have reported conflicting results regarding the form of viewpoint tuning. We have previously argued that these inconsistencies reflect differences in data analysis methods as well as low-level stimulus confounds. To date, no computational model has been able to account for the observed similarities and differences between these studies. Here, we propose a simple computational model that includes a small number of biologically-interpretable parameters. Our model replicates a number of key results reported across studies

investigating viewpoint sensitivity in human face-selective areas. We implemented a multilayered, randomly-connected feedforward network incorporating prominent biological constraints including: (i) cortical magnification in the input layer, (ii) incremental interhemispheric crossing of left and right hemifield representations in subsequent layers, and (iii) density of network connections. We also (iv) parameterized signal-to-noise characteristics, and (v) tested the impact of static measurement gain fields on the similarity structure of simulated brain patterns across different network layers. Our model takes as input the same face stimuli used in some of these neuroimaging studies, and accounts for a number of commonalities as well as important inconsistencies among studies. A single aspect of our model, the gradual increase of interhemispheric connections across layers, was sufficient to replicate view-tuned representations in early stages of the visual hierarchy, as well as a prevalence of "mirror-symmetry" in later processing stages. Differences in data analysis procedures accounted for the remaining inconsistencies observed in previous studies. Our results underscore the importance of incorporating biological constraints in computational models that aim to explain empirical observations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1387

Manipulating semantic consistency between two objects and a scene: an ERP paradigm

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Tim Lauer[1], Sage E. P. Boettcher[2], Diana Kollenda[1], Dejan Draschkow[2], Melissa L.-H. Vo[1]; [1]Scene Grammar Lab, Department of Psychology, Goethe University Frankfurt, [2]Brain and Cognition Lab, Department of Experimental Psychology, University of Oxford

An object that is semantically consistent with its scene context (e.g., a volleyball at a beach) is typically recognized better than an inconsistent object (a printer). This type of object-to-scene consistency effect has been reported in a number of behavioral and event-related potentials (ERPs) studies. Moreover, there is behavioral evidence that object-to-object relatedness modulates the recognition of objects in scenes. Here, we used ERPs to assess the contextual influence that two local objects may exert on each other and how they may interact with the global background scene context. Specifically, we looked at the N400 component, a known marker of semantic access in language and scene perception. Thirty-two participants

were presented with two objects superimposed on a scene for 2000 ms, on the left and right of a central fixation point. We manipulated both the semantic object-to-scene consistency and object-to-object relatedness, resulting in four conditions: 1) both objects are consistent with the scene and related to each other (CON_REL), 2) one object is consistent with the scene while the two objects are unrelated (CON_UNREL), 3) both objects are inconsistent with the scene and related to each other (INCON_REL), 4) both objects are inconsistent with the scene and unrelated to each other (INCON_UNREL). Participants completed a repetition detection task, requiring them to attend to both the objects and the scene. In the N400 time window, the INCON_UNREL condition evoked a more negative potential than all other conditions whereas all other possible comparisons were not significant. These data suggest that – in such a paradigm – one consistent relation of an object with either the scene or its object-to-object neighbor is enough to eliminate the inconsistency effect in the prototypical time window.

Acknowledgements: This work was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 222641018 – SFB/TRR 135 TP C7

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1078

Minimal evidence for task context effects on early visual object processing

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Joseph Borders[1] (borders.9@wright.edu), Assaf Harel[1]; [1]Wright State University

Human visual perception entails a complex interplay between top-down and bottom-up signals yielding fast and accurate object recognition. Recent neuroimaging findings have demonstrated that observer goals (manipulated by task context) modulate visual object processing across the cortex. While these findings reveal where task context influences object representations, they do not uncover when these effects emerge (i.e. early vs. late). To identify how early the impact of task context can be observed, we recorded Event-Related Potentials (ERPs) from participants as they viewed objects from four categories spanning

animacy and real-world size dimensions under four tasks, two of which required judments of the objects' animacy and size. We examined how the relevance of the task context impacted object processing across both time and space by measuring the effects of task relevance in two time windows (0-300ms and 300-600ms post stimulus onset), and across two sites: an occipital electrode site (Oz) and a central-parietal location (Cz). We found that activity distinguishing animate and inanimate objects was greatest under the task relevance context (i.e. under the animacy task) compared to the task irrelevant context (i.e. under the size task). However, the effect of task relevance was relegated to cognitive, post-perceptual stages, occurring primarily in the later time-window and specific to the central-parietal site. Interestingly, the effect of task relevance on real-world size discrimination while also observed in the late time-window, was not site-specific. Together, these results suggest task-related processing occurs post-perceptually (>300ms post-stimulus onset) following initial object processing and suggests task-related information is first processed outside of early visual areas in frontoparietal regions.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

Thank you for viewing my poster. Please let me know if you have any questions or comments - borders.9@wright.edu.

Abstract ID: 550

Neural mechanism of orientation selectivity for distinct gamma oscillations in cat V1

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Chuanliang Han[1] (hanchuanliang2014@163.com), Bin Wang[1], Guanzhong Yang[1], Weifeng Dai[1], Yi Yang[1], Tian Wang[1], Yang Li[1], Chun-I Yeh[2], Dajun Xing[1]; [1]Beijing Normal University, [2]National Taiwan University

Gamma-band (30-100Hz) activity in the local field potential (LFP) is commonly observed in different brain structures and thought to play important roles in information processing. Recent studies showed that two distinct oscillatory components peaking in gamma band (low gamma and high gamma) exist in the LFP of primary visual cortex (V1). However, the neural mechanisms for generating the two gamma components and their distinct response properties are poorly understood. Here, we simultaneously recorded from visual area 18 and the lateral geniculate nucleus (LGN) of anesthetized cats and collected their neural activity (both LFP and multi-unit activity, MUA) to drifting grating stimuli with different orientations. We found two gamma components (low gamma, 50-65Hz, high gamma, 70-100Hz) coexist in cat V1, and the orientation

tunings of the two gamma components and spike activity (measured by MUA) are significantly different. Orientation selectivity, quantified as the circular variance (CV), of MUA is significantly higher than the selectivity of both low gamma component (average CV difference is 0.12; t-test: $t=6.6$, $p<0.001$) and high gamma components (average CV difference is 0.23; t-test: $t=14.9$, $p<0.001$); but the CV of low gamma is more similar to the CV of MUA. Interestingly we found that the ratio of low-gamma power and high-gamma power is positively correlated with circular variance of MUA ($r=0.55$, $p<0.001$), low-gamma ($r=0.64$, $p<0.001$) and high-gamma ($r=0.4$, $p<0.001$). Moreover, only high gamma component is found in the LGN, indicating that low gamma component originates within V1, possibly through recurrent neural network. As the strength of recurrent neural network increases, the orientation selectivity of V1 output gets weaker. Our work demonstrates multiple sources for gamma oscillation and this property might give us a useful tool to probe feedforward and recurrent connections to functional properties in the brain.

Acknowledgements: This work was supported by National Key Basic Research Program of China 2014CB846100 and 2014CB846101, National Natural Science Foundation of China Grant (31371110), and the BNU Interdisciplinary Research Foundation for the First-Year Doctoral Candidates (BNUXKJC1909)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1116

The unreliable influence of noise normalization on the reliability of neural dissimilarity in visual and non-visual cortex

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

J. Brendan Ritchie[1] (j.brendan.w.ritchie@gmail.com), Haemy Lee Masson[1], Stefania Bracci[2], Hans Op de Beeck[1]; [1]Laboratory of Biological Psychology, Brain and Cognition, KU Leuven, Leuven, Belgium, [2]Center for Mind/Brain Sciences - CIMeC, University of Trento, Rovereto, Italy

Representational similarity analysis (RSA) is increasingly part of the standard analytic toolkit in neuroimaging studies investigating the organization of visual cortical regions. Core to RSA is the measuring of neural dissimilarity between the response patterns for different conditions to construct neural representational dissimilarity matrices (RDMs) for comparison with those constructed from behavioral data or computational models of visual processing. It has been proposed that noise normalizing these patterns, and using cross-validated distances as a dissimilarity measure, is superior for characterizing the structure of

neural RDMs for visual and not-visual brain regions (Walther et al. 2014). This assessment has been motivated by results suggesting improvement in within-subject neural dissimilarity after noise normalization. However, between-subject reliability is more directly related to determining the amount of explainable variance, and the evaluation of observed effect sizes when they are correlated with behavioral or model RDMs. To further evaluate the impact of noise normalization we re-analyzed three data sets that included activity patterns from multiple ventral visual pathway regions, and also non-visual regions. Across the three datasets, using multiple measures of dissimilarity (correlation distance, classifier accuracy, cross-validated Euclidean distance, and cross-validated Mahalanobis distance) we did not find that noise normalization consistently boosts within-subject reliability, between-subject reliability, or correlations with behavioral or model RDMs. In fact, in some cases, it made things worse (Charest, Kriegeskorte, and Kay, 2018). Overall, our results provide equivocal support for the utility of noise normalization to RSA, the impact of which may depend heavily on the stimulus, visual region of interest, and dissimilarity measure used.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 515

Transformations of Object Representations Across the Human Visual Processing Hierarchy

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Viola Mocz[1] (viola.mocz@yale.edu), Maryam Vaziri-Pashkam[2], Marvin Chun[1], Yaoda Xu[1]; [1]Yale University, [2]National Institute of Mental Health

Previous work has shown that we can derive linear transformation functions within human lateral occipital cortex for affine changes (i.e. size and viewpoint) of objects that can then predict the neuronal response of such changes for new object categories (Ward et al., 2018, J Neurosci). In the current study, we explored such transformations within brain regions of interest (ROIs) along the ventral stream of the human visual hierarchy, including V1, V2, V3, V4, ventral occipitotemporal cortex (VOT), and lateral occipitotemporal cortex (LOT). We examined data from four existing fMRI experiments (Vaziri-Pashkam and Xu, 2018, Cereb Cortex; Vaziri-Pashkam et al., 2018, J Cogn Neurosci) and analyzed four types of transformations: 1) original format vs. controlled format (equalized image contrast, luminance and spatial frequency across all categories using the SHINE toolbox in Matlab), 2) appearing above fixation vs. below fixation, 3) small size

vs. large size, and 4) high spatial frequency vs. low spatial frequency. Using linear transformation, we can successfully predict neural responses between these four types of transformations throughout the human ventral visual pathway. However, for the transformations of position, size, and spatial frequency, we can only generalize the learned transformations to a new object category in LOT and VOT but not in early visual areas, whereas for the transformation of original vs. controlled format, we can generalize the learned transformations to a new object category in all ventral ROIs examined. These results indicate that higher-level visual regions represent transformations in a category-independent manner, while lower-level visual regions largely represent transformations in a category-dependent manner.

Acknowledgements: Grant information: NIH 1R01EY022355

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1262

Tuned representational similarity analysis: Improving the fit between computational models of vision and brain data

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Philipp Kaniuth[1] (kaniuth@cbs.mpg.de), Martin N Hebart[1]; [1]Max Planck Institute for Human Cognitive and Brain Sciences

In cognitive neuroscience, representational similarity analysis (RSA) is a common method to assess the correspondence between representations in computational models, brain and behavior. RSA is based on comparing representational dissimilarity matrices (RDMs), which are composed of pairwise dissimilarities between responses to all pairs of stimuli or conditions (e.g. voxel activity, model features). However, this approach of computing dissimilarities treats each feature of a computational model as equally important. As a consequence, classical RSA may underestimate the information represented in these models and may lead to biases in model selection. To address these issues, we propose “tuned RSA”, a refinement of RSA based on additive clustering (Shepard & Arabie, 1979; Peterson et al., 2018). Instead of directly relating two RDMs, this approach linearly reweights each model feature to maximize the correspondence between both RDMs. Therefore, dissimilarity of activity patterns in the brain is predicted by a linear combination of the dissimilarity in each model feature. We validated tuned RSA on object-selective cortex activity in two publicly available fMRI datasets of real-world object images (92 and 118 conditions, respectively) and

tested the correspondence with deep neural networks, semantic embeddings, and MEG data for MEG-fMRI fusion. Across all models and both datasets, tuned RSA led to strong increases in the amount of variance shared between both RDMs, never reducing and in some cases even doubling the explained variance. Sanity checks in control regions of interest and on noise data confirmed that this was not due to overfitting. RSA promises important insights into which models capture best how the brain represents relations between stimuli or conditions. Tuned RSA thus has the potential to become a general purpose method for measuring the information content shared between representations in computational models, brain, and behavior, and may improve our ability as scientists to adjudicate between competing models.

Acknowledgements: This work was funded by a Max Planck Research Group grant to MNH.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1076

Visual input influences behavioral detection of optogenetic stimulation in macaque inferior temporal cortex

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Simon Bohn[1], Arash Afraz[1]; [1]National Institute of Mental Health, Laboratory of Neuropsychology

A macaque monkey was trained to behaviorally detect 200ms impulses of optogenetic stimulation delivered to its inferior temporal (IT) cortex while viewing images of objects. In each trial, the image displayed was independent of stimulation condition, and the animal was only rewarded for correctly identifying whether the trial did or did not contain stimulation. To stimulate IT cortex, we used the depolarizing opsin C1V1 targeting cells that express CAMKIIa in combination with a novel, chronically implanted optical array composed of 24 individually controlled LEDs each capable of producing up to 60mW green (527nm) light. The animal was able to robustly detect optical impulses delivered to its transduced cortex (mean 89% correct, chance level 50%, Chi-squared $p<0.0001$). To the best of our knowledge, this is the largest behavioral “effect size” of optogenetic brain perturbation in a nonhuman primate reported to date. Moreover, we observed that the animal’s performance on this task was heavily

influenced by visual input to the retinae. The performance in detection of the optical impulse ranged from 74% to 100% correct depending on what image was viewed during the trial (bootstrapping, p<.001). These findings reveal that for a given imageset, there exists a unique “detection profile” that is composed of the animal’s cortical stimulation detection rates while viewing each image in the set. Changing the cortical position of stimulation changes the detection profile; across days of testing, detection profile is more correlated within a stimulation site, than between two different sites (bootstrapping, p<.001). These results show that optogenetics can be used to induce large behavioral effects in nonhuman primates. Strong interaction of the task with visual input suggests that the animal detects the cortical stimulation based on an induced visual event.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Hi everyone, thanks for coming to my poster! I'll be around, but feel free to email me any questions you might have at simon.bohn@nih.gov

One small note of clarification that I forgot to mention in the poster and video: In trials with visual images shown during them, only one image is shown per trial.

Abstract ID: 1425

What do leave-one-person-out pattern analyses really tell us about the neural representation of visual object symmetries?

Poster Presentation - *Topic area: Object Recognition: Models and mechanisms*

Fernando M. Ramirez[1] (fernando.ramirez@nih.gov), Cambria Revsine[1], Elisha P. Merriam[1]; [1]Laboratory of Brain and Cognition, NIMH

A key challenge in human neuroscience is to gain information about neural population codes using indirect measures of neural activity. Recently, a multivariate pattern analysis method termed Leave-One-Person-Out (LOPO) has been used to support inferences regarding neural coding. Two key caveats, however, have been overlooked by users of this method: (1) its sensitivity to low-level feature imbalances across conditions (e.g. image contrast, luminance, and their variability over instances of each stimulus class), and (2) implausibility of the methods’ assumption that spatial normalization meaningfully aligns neural patterns of activation across subjects. Here, we show with simulations instantiating multilayered randomly

connected feedforward networks that LOPO leads to erroneous conclusions when the methods' assumptions are not met. In particular, low-level properties of the images chosen by an experimenter are shown to largely determine the observed pattern of results, and not the covariance structure of the underlying spatial patterns of activation. We further show how deceptively complex representational structures emerge due to specifics of the LOPO analysis scheme. Interestingly, simulations initially intended to study the general behavior of LOPO led to concrete predictions regarding the relative norms, means and variances of images from an image database recently used in multiple recent neuroimaging studies. Low-level feature imbalances of the precise form predicted by our model were confirmed by ensuig direct analyses of these images. We argue that under plausible assumptions regarding the fMRI measurement process, the observed confounds may account for recent putative evidence of mirror-symmetric tuning of neural populations in a human face-selective area. In sum, we conclude that (1) LOPO is particularly sensitive to low-level image feature imbalances across conditions, and (2) the method's sound interpretation hinges on implausible assumptions. Our observations cast doubts on the validity of LOPO analyses to support inferences that require the detection of spatially structured brain patterns.

Acknowledgements: This work was supported by the Intramural Research Program at NIMH. We thank Chris Baker, Steve Gotts, and Alex Martin for useful comments and suggestions.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

I wholeheartedly recommend to download the video and watch it at approx. 80% speed :)
This is easy to do with VLC media player, go to the "Playback" menu, under the option "Playback speed" and toggle to set the speed that suits you best.

Follow me on Twitter: @FRamirez_R2

Abstract ID: 1445

Object Recognition: Neural mechanisms

Neural correlates of visual awareness and task-relevance in a no-report masking paradigm

Talk Presentation - *Topic area: Object Recognition: Neural mechanisms*

Kevin Ortego[1], Michael Pitts[1], Michael Cohen[2]; [1]Reed College, [2]Amherst College

What are the neural signatures associated with perceptual awareness? The P3b event-related potential (ERP) has been widely claimed to differentiate between visible and invisible stimuli. For example, Dehaene et al. (2001) observed widespread neural activation and a P3b only in response to visible stimuli. However, it is unclear if this activation is associated with perceptual awareness or post-perceptual processes (e.g., memory encoding, decision-making, motor planning, etc.). To examine this possibility, we used a visual masking paradigm to manipulate awareness (i.e., visible vs. invisible) and task-relevance (i.e., report what you saw vs. do not report what you saw). Here, the target stimuli were line drawings of animals and objects that appeared for 33ms. In the masked condition, 100ms masks immediately preceded and followed the stimuli, while in the visible condition, the masks were separated from the stimuli by 200ms blank periods. During task-relevant blocks, subjects reported whether they saw an animal, object, or nothing. In the task-irrelevant blocks, subjects made no responses to the animals and objects. Instead, they counted how many times a green circle appeared and provided their answer after each block. Critically, the stimuli were identical between the two conditions. The only thing that changed was the task being performed. In the task-relevant condition we found a robust P3b wave (300-600ms), replicating previous results. In the task-irrelevant condition, however, no such wave was observed (Bayes factor=0.001). ERP decoding analyses, in which we trained classifiers on the task-relevant condition and tested them on the task-irrelevant condition, revealed that only early (<300ms) neural dynamics generalized across conditions. We replicated the P3b and decoding results in a second experiment in which stimuli were always visible (unmasked). Overall, this pattern of results suggests that the P3b is related to task performance, while earlier ERPs may be more closely linked with visual awareness.

Acknowledgements: NSF Grant #BCS-1829470

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Here's a link to the paper in Journal of Neuroscience if you are interested.

http://www.michaelacohen.net/uploads/5/9/0/7/59073133/sn-jnsj200156.pdf

Abstract ID: 1600

Object-selective cortex shows distinct representational formats along the posterior-to-anterior axis: evidence from brain-behavior correlations

Talk Presentation - *Topic area: Object Recognition: Neural mechanisms*

Caterina Magri[1] (cmagri@fas.harvard.edu), Talia Konkle[1]; [1]Harvard University

Object information is transformed along the ventral visual stream from early formats into increasingly invariant representations. To gain insight into the nature of these representations, we measured different facets of similarity with three behavioral tasks and related them to neural responses. First, we measured similarity implicitly using a visual search task, measuring the time it took participants to find one target amongst distractors in a large-scale online experiment (72 images of inanimate objects, 2,556 pairs, n=1,272). Next, we measured similarity with an explicit shape-sorting task, asking participants to arrange items in a circular arena based on their shape similarity (n=25). Then, we measured similarity with the same task, but without any guidance on what object properties to focus on while placing more similar objects nearby (n=26). Finally, brain responses to each image were obtained using functional magnetic resonance imaging (n=10). Our results show that (i) there are clear differences in the measured similarity space of objects across tasks, (ii) the implicit visual search similarity was most strongly correlated with the posterior half of object-selective cortex, (iii) the explicit shape-sorting similarity was most strongly correlated to the anterior half of object-selective cortex, and (iv) the similarity measured with the unguided sorting task was not well-correlated with any responses along occipitotemporal cortex. These observations were confirmed quantitatively with linear mixed-effect modeling: the brain similarity structure along the hierarchy was better explained when including the interaction between behavioral task and location along the hierarchy, compared to a model without the interaction: $\chi 2(34)=178.73$, $p<0.001$). Broadly, these results reveal a clear dissociation in the way posterior and anterior occipitotemporal cortex represents the similarity of objects. We hypothesize that this relatively sharp transition along the ventral stream hierarchy may reflect a passage from more pictorial to more structural representations of inanimate object information.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 185

Perceptual and conceptual representations of objects in the human brain

Talk Presentation - *Topic area: Object Recognition: Neural mechanisms*

Christina Dimitriadou[1,2] (cxd889@student.bham.ac.uk), Lara Oliel[3], Ian Charest[1,2]; [1]School of Psychology, University of Birmingham, [2]Centre for Human Brain Health, University of Birmingham, [3]Sorbonne University, Pierre and Marie Curie Campus

Previous research reported high-level object representations in the visual ventral stream (VS) at the interface between perception and semantics, reflecting behavioural similarity judgements. Here we used representational similarity analysis (RSA) to investigate object recognition (36 objects including bodies, faces, objects and scenes) comparing three behavioural tasks with functional magnetic resonance imaging (fMRI, 3T, n=20) and electroencephalography (EEG, 128 channels, n=20). In an attempt to capture implicit similarity representations, we used a novel discriminability task. As a measure of explicit similarities, we collected behavioural judgments using the multiple-arrangements (MA) task. Finally, to capture semantic representations, we obtained human-derived caption labels. We predicted that implicit similarity judgements would better capture perceptual representations, while explicit and semantic judgments would extend to higher-level, semantic or conceptual brain processes. Representational dissimilarity matrices (RDMs) were estimated using drift-rates for the discriminability task, using pixel euclidean distances for the multi-arrangements task, and using sentence embeddings of the human captions for the semantic labelling task (Figure 1A). We relate these behavioural RDMs to time-resolved RDMs (EEG, Figure 1B) and searchlight-defined RDMs (fMRI, all statistics are reported with p<0.001 corr., Figure 1C). The EEG-RDMs showed large and early peak correlations with the discriminability task, and weaker correlations for the semantic and multi-arrangement tasks (later in time). In fMRI, we see all three behavioural tasks strongly mapping (t values reaching 48.9) on the visual ventral stream (strongest for the discriminability task). The multi-arrangement and semantic tasks additionally involved higher-order regions of the medial temporal lobes and prefrontal cortices. Our results suggest that implicit similarity judgements better capture representational geometries in visual cortex but fail to predict higher-order representations. In contrast, multi-arrangements and semantic judgements account for higher-level representations. Therefore, we propose that accounting for behaviourally relevant information processes in the brain should rely on a battery of behavioural metrics.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Please feel free to contact me with any questions, comments or suggestions.

Email: CXD889@ student.bham.ac.uk

Abstract ID: 764

Representation of information prediction in the brain

Talk Presentation - *Topic area: Object Recognition: Neural mechanisms*

Yuening Yan[1] (2417676y@student.gla.ac.uk), Jiayu Zhan[2], Robin Ince[3], Philippe Schyns[4]; [1]Institution of Neuroscience and Psychology, University of Glasgow

The human brain can generate information predictions to facilitate visual processing. We used a cued left vs. right Gabor patch orientation task to trace the dynamics of visual information predictions. On each trial, three observers categorized low and high spatial frequency Gabor patches displayed at one of 3 orientations (-15, 0, +15 deg.) at one of two locations (right vs. left visual field) while we measured their brain's magnetoencephalographic (MEG) activity. In a two-stage cueing design, a visual cue (a dot on the screen) predicted the visual field location of the incoming Gabor, followed by an auditory cue (at 220 Hz, LSF; 1760 Hz, HSF; 880 Hz, uncued control) that predicted the spatial frequency (SuppFig. 1-A, B). Observers indicated the spatial frequency of the Gabor with a key press. As expected, valid cueing reduced reaction times in all observers, p<0.001, observer 1: 562 vs. 662ms, observer 2: 390 vs. 515ms, observer 3: 454 vs. 505ms, SuppFig. 2. We traced the prediction dynamics in the 1s that followed the spatial and auditory cues by computing the mutual information between the cue and the corresponding responses of 12,773 MEG voxels sampled every 2ms. Spatial cueing induced an early (123-136ms post spatial cue) contra-lateral representation of the dot cues in occipital cortex that extended to frontal regions (189-246ms) and came back as a prediction in occipital cortex (326–363ms, SuppFig. 3 and 4). Auditory cuing revealed a similar early representation in auditory cortex (80–91ms post auditory cue), followed by an extension to frontal regions (156-207ms) and a prediction back into occipital cortex (334–359ms, SuppFig. 4). Our results indicate that the early sensory processing of a cue (visual or auditory) propagates first to frontal area from which we traced a backward flow into occipital cortex that speeds up perceptual decisions.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

E-mail: 2417676y@student.gla.ac.uk
Any comments or questions are welcomed!

Abstract ID: 1044

The two-body configuration in visual perception

Talk Presentation - *Topic area: Object Recognition: Neural mechanisms*

Etienne Abassi[1] (etienne.abassi@gmail.com), Liuba Papeo[2]; [1]Centre National de la Recherche Scientifique

Human social nature has shaped visual perception. The relationship between vision and sociality is reflected in the attunement of specialized visual are to social entities such as faces and bodies. We asked whether human vision also exhibits a special sensitivity to spatial relations that reliably correlate with social relations. In general, interacting people are more often situated face-to-face than back-to-back. Using functional MRI (fMRI) and behavioral measures in healthy subjects (Study 1), we showed that visual sensitivity to social stimuli extends to images including two bodies facing toward (vs. away from) each other. In particular, the body-selective extrastriate body area (EBA) responded to facing bodies more strongly than identical, but nonfacing, bodies. In this area, multivariate pattern analysis revealed an accurate representation of body dyads with sharpening of the representation of single-body postures in facing dyads, which suggests an effect of visual context on the perceptual analysis of bodies. Those neural effects were accompanied by an increased cost of inversion (upside-down rotation) on recognition for facing dyads (relative to nonfacing dyads), a behavioral signature of the specialized mechanisms for body (and face) perception. A congruent effect was found selectively in the EBA, when we presented upright vs. inverted facing and non-facing dyads (Study 2): the cost of inversion (reduced activity for inverted vs. upright stimuli) was larger for facing than nonfacing dyads. Thus, spatial relations between multiple bodies are encoded in the same region for body perception and affect the way in which bodies are processed. Particularly, the body-selective cortex is especially sensitive to a spatial configuration encompassing two bodies facing one another, as shown by increased neural activity and increased inversion effect. This two-body configuration in the human visual cortex may represent the perceptual rudiment of the representation of events.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

Hello, thank you for your interest in my research !
It looks like my video is not working. While I try to fix it, you can see it here:

https://drive.google.com/file/d/10DP_hgzUNYbqGA8Kc7HlBmlvE-9eIc0T/view

Do not hesitate to ask me any questions in the chat, or we can have additional live conferences if none of the ones scheduled fit in you time zone.
You can contact me at etienne.abassi@isc.cnrs.fr for any questions.

Have a nice v-vss meeting !
Etienne

Abstract ID: 1112

White matter anatomy and cortical microstructure predict reading-related responses in ventral temporal cortex

Talk Presentation - *Topic area: Object Recognition: Neural mechanisms*

Mareike Grotheer[1], Jason Yeatman*[2,3], Kalanit Grill-Spector*[1]; [1]Psychology Department, Stanford University, [2]Graduate School of Education, Stanford University, [3]Division of Developmental and Behavioral Pediatrics, Stanford University, *Authors contributed equally

Reading-related responses in the ventral temporal cortex (VTC) show a consistent spatial layout across individuals, which is puzzling, since reading skills are typically acquired during childhood. Moreover, while peak responses generally fall within the occipito-temporal sulcus (OTS), the precise location within this sulcus can vary. Here, we tested the hypothesis that specific white matter fascicles and microstructural properties of the gray matter constrain where reading-related responses emerge in VTC in a given individual. Thus, we obtained functional (fMRI), diffusion (dMRI), and quantitative (qMRI) magnetic resonance imaging data in 30 adults. fMRI was used to map reading-related responses by contrasting responses in a reading task with those in an adding and a color task performed on the same visual stimuli (Grotheer et al., 2018, 2019); qMRI was used to measure proton relaxation time (T1), which is dependent on tissue microstructure; dMRI was used to automatically identify the 6 fascicles that connect to VTC and to map their endpoints density (ED) on the cortical surface. Within VTC, ED and T1 were then used to predict reading-related responses. First, linear regression with leave-one-subject-out cross-validation in a subset of participants (N=10), showed that ED of the arcuate fasciculus (AF), inferior longitudinal fasciculus (ILF), and vertical occipital fasciculus (VOF) significantly predict reading-related responses. Adding gray-matter T1 to a model that combines AF, ILF and VOF endpoints significantly improved the model. Finally, evaluation of the full structural model in the remaining participants with leave-one-subject-out cross-validation showed that this model i) significantly predicts the topology of reading-related responses across VTC and ii) predicts the location of reading-related regions of interest known as the visual word form areas. Overall, our data-driven approach reveals that the AF, ILF, VOF and T1 predict responses in VTC, suggesting that these structural features of the brain constrain the location of reading-related responses.

Acknowledgements: This research was supported by the National Institute of Health (NIH; R01EY023915, R01MH121868 and R01HD09586101)

This talk will be presented in Live Talk Session 7, Tuesday, 23 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 201

Object Recognition: Processes

“Steep” and “shallow” visual learners: Individual differences in category trainability

Poster Presentation - *Topic area: Object Recognition: Processes*

Michaella Trites[1] (mtrites@uvic.ca), Jim Tanaka[1], Stuart MacDonald[1], Jose Barrios, Buyun Xu; [1]University of Victoria

In visual categorization studies, participants are frequently trained to a specified level of competency with respect to their accuracy (Scott, Tanaka, Sheinberg, & Curran, 2008; Tanaka, Curran, & Sheinberg, 2005). This approach assumes that once the training criterion has been met, participants are equated in performance accuracy. However, less attention has been given to how individual differences in the rate at which a participant learns a visual category predicts subsequent post-acquisition performance. In this study, we investigate the trainability of participants as a predictor of their ability to retain category knowledge. In Phase 1, participants were trained to categorize images of four species of warblers (Capemay, Townsend, Prairie, and Magnolia) to a 90% learning criterion. The training was administered on a smartphone that recorded both accuracy and response time. Multilevel modeling was used to derive individual acquisition slopes using baseline accuracy and number of trials-to-criterion which allowed participants to be classified into “steep” and “shallow” learners. In Phase 2 participants completed refresher sessions conducted one, two and three days after the initial training. For these sessions, participants categorized new images of the warbler species for a fixed number of trials with feedback. Steep learners showed continued gains during the post-acquisition phase with their accuracy reaching near ceiling levels of 97%. The shallow learners showed the opposite effect. Despite receiving corrective feedback, their accuracy declined to around 80%, significantly below the initial 90% learning criterion that they achieved in the training phase of the study. We speculate that whereas the steep learners were efficient in updating and refining their category representations, the shallow learners were less efficient in utilizing the feedback to modify their category representations. Our results suggest one’s “trainability” on a visual category task predicts future success in their ability to retain and refine visual category representations.

Acknowledgements: This work was supported by a grant to James Tanaka from the Natural Sciences and Engineering Research Council of Canada.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1732

Accessing object concepts: Effects from brief exposure using anaglyphs

Poster Presentation - *Topic area: Object Recognition: Processes*

Caitlyn Antal[1] (caitlyn.antal@mail.concordia.ca), Roberto G. de Almeida[1]; [1]Concordia University

We sought to investigate how concepts are accessed via object and feature recognition during two brief exposure times (50/60 or 190/200 ms). Participants performed a picture/word masked priming congruency task, whereby they had to judge whether a picture/word pair were related to each other. Participants wore blue-red anaglyph glasses, with objects presented in red in the left visual field and words presented in blue in the right visual field. Using anaglyphs allowed us to investigate the role of the early posterior visual projections during object and word recognition, by projecting the word to the visual word form area in the left hemisphere and the picture to the right temporal lobe--one of the bilateral object recognition areas. Pictures and target words were presented simultaneously with a 10 ms difference accounting for their recognition times: objects were presented for 50 or 190 ms, while words were presented for either 60 ms or 200 ms. For each picture, one of four word probes was presented for congruency decision: the basic level category label of the picture (dog), a high-prototypical (bark), a low-prototypical (fur), or a superordinate feature (pet). Response times (RTs) and accuracy to congruency decisions were analyzed through linear mixed effects models. Results showed that participants were faster and more accurate in responding to picture-word pairs when stimuli were presented for 190/200 ms rather than 50/60 ms. Furthermore, high prototypical and superordinate feature probes yielded significantly faster and more accurate responses when stimuli were presented for 190/200 ms. But crucially, basic level probes yielded significantly faster RTs and greater accuracy than all other probe types, at both presentation times. Taken together, this suggests that concept tokening relies on non-decompositional processes, and that conceptual features are processed only after concepts have been accessed.

Acknowledgements: NSERC - Natural Sciences and Engineering Research Council and SSHRC - Social Sciences and Humanities Research Council

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have any questions, please feel free to email me at caitlyn.antal@mail.concordia.ca.

Abstract ID: 945

Does statistical regularity influence detection? Famous vs novel logos and canonical vs noncanonical viewpoints

Poster Presentation - *Topic area: Object Recognition: Processes*

Pei-Ling Yang[1] (plyang2@illinois.edu), Evan G Center[1,2], Diane M Beck[1,2]; [1]Department of Psychology, University of Illinois, [2]Beckman Institute, University of Illinois

We have previously shown that statistical regularity impacts our ability to see briefly presented masked scenes. That is, scenes that were probable (Greene et al., 2015) or representative (Caddigan et al., 2017) of their category (good exemplars) were more likely to be detected than those that are improbable or less representative of their category (bad exemplars). Here we extend the concept of statistical regularity to familiarity, acquired over the lifetime (famous) and within the experiment (repeated), and to logos and isolated objects. We used the same intact scrambled task in which subjects must discriminate intact images from scrambled images. Famous logos were selected across different categories, such as food chains (McDonald’s, Starbucks, etc.), and technology (Apple, Google, etc). Novel logos were computer-generated logos for the same products. Objects were computer-generated household items rendered in canonical and noncanonical viewpoints. As predicted on the basis of statistical regularity, subjects ($n = 26$) had higher d’ (for intact vs scrambled) for the famous logos ($d' = 2.40$) than computer-generated logos ($d' = 2.22$; $t(25) = 2.35$, $p = .027$), indicating that statistical regularity influences detectability even for simple highly stylized stimuli. Short-term familiarity (acquired within the context of the experiment) did not affect detectability; repeated logos, whether famous ($d' = 2.43$) or not ($d' = 2.16$), had equivalent d’s to those presented for the first time in the experiment, $d' = 2.40$ and $t(25) = -.20$, $p = .84$ for famous logos and $d' = 2.22$ and $t(25) = .56$, $p = .58$ for novel logos. Similarly, subjects ($n = 20$) had higher d’ for canonical object viewpoints ($d' = 2.67$) than noncanonical ($d' = 2.30$; $t(19) = 5.05$, $p < .001$). Together, these data support the idea that statistical regularity influences the detection of simple highly stylized logos and isolated objects.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 146

Evidence that the Brain's Physics Engine Runs Forward Simulations of What will Happen Next

Poster Presentation - *Topic area: Object Recognition: Processes*

RT Pramod[1] (pramodrt@mit.edu), Michael Cohen[1,2], Kirsten Lydic[1], Josh Tenenbaum[1], Nancy Kanwisher[1]; [1]Massachusetts Institute of Technology, [2]Amherst College, Amherst, MA

Human vision enables us not only to recognize what is where, but to understand the physical properties, relations and forces in a scene and use this information to predict what will happen next. Recent work suggests that these intuitive physical inferences are based on probabilistic simulations of a mental physics engine akin to the physics engines used in video games. Indeed, parietal and frontal regions have been implicated as the "brain's physics engine", as they are strongly engaged during intuitive physical inference, and they contain information about object mass. Here, we used fMRI to test the hypothesis that these brain regions conduct simulations of what will happen next. Specifically, we predicted a higher response in these regions for static images of real-world scenes that depict a) unstable configurations of objects or of people in precarious positions (expected to induce forward simulation) than b) stable configurations (where less simulation is expected). Six subjects fixated a cross through the experiment (verified via eye-tracking), and performed an orthogonal 1-back task on stimuli arranged in a blocked design. As predicted, we found significantly higher responses in independently-defined parietal "physics regions" when participants viewed unstable vs stable scenes ($p=0.004$ for a paired t-test across subjects). Moreover, similar effects were found in visual motion area MT, also consistent with greater simulation for unstable than stable stimuli. This increased response is unlikely to reflect differential eye movements, low-level stimulus differences (as stable versus unstable stimuli elicit equal responses in V1 and were not decodable in early layers of a CNN), or differential attention (as no increased response was found for animate rather than physical instability, e.g. a person being chased by a shark). These results suggest that "the brain's physics engine" computes information about physical stability based on forward simulations of what will happen next.

Acknowledgements: This work was supported by NIH grant Grant DP1HD091947 to N.K and National Science Foundation Science and Technology Center for Brains, Minds, and Machines.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1521

Localising the information processing neural sources underlying the N170 event related potential

Poster Presentation - *Topic area: Object Recognition: Processes*

Y Duan[1] (y.duan.1@research.gla.ac.uk), J Gross[1,3], RAA Ince[1], PG Schyns[1,2]; [1]Institute of Neuroscience and Psychology, University of Glasgow, [2]School of Psychology, College of Science and Engineering, University of Glasgow, [3]Institute for Biomagnetism and Biosignalanalysis, University of Muenster, Germany

The N170 event related potential (ERP) observed in EEG has been related to representation and processing of faces, as well as linked to expertise in other object categorisation tasks. To explicitly investigate neural sources of the specific stimulus information sensitivity of the EEG N170 we asked participants to perform four different categorization tasks on the same set of stimulus images (FigA). The four 2-AFC tasks were: 1. happy vs. neutral central face; 2. male vs. female central face; 3. male vs. female pedestrian; 4. normal car vs. SUV. In each trial, the stimulus information is randomly sampled with Bubbles and categorisation responses, MEG and EEG are simultaneously recorded. Our goal is to co-localise the specific stimulus information sensitivity of the N170 ERP for both faces and objects, with the concurrently recorded source localised MEG signal. Mutual Information (MI) between stimulus samples and responses (FigB) shows the specific image information that must be represented in the brain as the participants perform the task. We extracted stimulus features by summing bubble masks within task-specific regions of interest. We determined the stimulus sensitivity of the EEG at sensor level and MEG at source level by calculating MI between the stimulus feature and the recorded signals. We then quantified the common trial-by-trial representation between the two modalities using redundancy: Red(sensor EEG; source MEG; stimulus feature). Focussing on the face expression task the eyes are represented in sensor level EEG signals around 200ms, during the second half of the N170 (FigC). Redundant information in the concurrent source MEG is shown in occipital cortex and fusiform gyrus. These results demonstrate the potential of information theoretic methods to relate specific stimulus information processing between different imaging modalities on a trial-by-trial basis, and thereby gain insight into the underlying neural information processing mechanisms.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1786

Masking, crowding and grouping: studying low and mid-level vision in a diverse cohort using a common framework

Poster Presentation - *Topic area: Object Recognition: Processes*

Josephine Reuther[1] (j.reuther@abdn.ac.uk), Ramakrishna Chakravarthi[1], Jasna Martinovic[1]; [1]University of Aberdeen

Whether visual information is individuated or texturized is susceptible to modulation at multiple processing levels. Commonly, low and mid-level visual processes are studied using disparate stimuli and tasks in a relatively small number of often well-trained observers. Here, we examine the dependencies in processing across multiple levels by investigating three phenomena (masking, crowding and grouping) that target these levels of processing within the same participants while using a common stimulus consisting of 9 Gabor elements. Contrast thresholds were assessed in more than 50 observers (age range: 20 to 70) for several inter-element distances in parafoveal (3.5 deg) and peripheral (7 and 10.5 deg) locations using a spatial two-alternative forced-choice procedure. The aim of the study is to build a unitary framework of low and mid-level vision and to assess the extent to which perceptive fields (masking), integration fields (crowding) and association fields (grouping) are co-dependent. Using tasks that incentivize participant behavior (integrate vs. individuate) in line with the phenomena of interest, we elicited signatures of masking, crowding and grouping. For all three phenomena we find that contrast thresholds were modulated by inter-element distance, with a shallower and inverted effect for grouping compared to masking and crowding. That is, the pattern of results was qualitatively similar for masking and crowding, but not for grouping. Inter-observer variability increased with eccentricity and with the putative size of the visual field upon which visual processing is reliant, with the highest variation at 10.5 degrees eccentricity for grouping.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
21 June, 6:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1209

Object recognition at the level of minimal images develops for up to seconds of presentation time

Poster Presentation - *Topic area: Object Recognition: Processes*

Daniel Harari[1] (hararid@weizmann.ac.il), Hanna Benoni[2], Shimon Ullman[1]; [1]Weizmann institute of science, [2]The College of Management Academic Studies (COLLMAN), Israel

Discovering the visual features and representations used by the brain to recognize objects is a central problem in the study of vision. A recent study found that at the level of minimal recognizable images (coined MIRCs, at mean resolution of 15 image samples) a minute change of the image (reduction by either size or resolution) can have a drastic effect on recognition, thus, identifying features that are critical for the task. Here we study the time trajectory of the recognition process at the level of MIRCs, by controlling the display exposure time and image masking. Participants were instructed to name the object in each of the presented MIRC images. Subjects were assigned to one of nine exposure conditions: 200, 500, 1000, 2000msec with or without masking, and unlimited time. The time to respond after presentation was unlimited. The results show that in the masked conditions recognition rates remained as low as 32% for 200msec and 46% for 500msec exposure, while increasing exposure times significantly increased recognition rates, even for exposure longer than 2000msec. Recognition rates were significantly lower in masked compared to unmasked presentations. In a control experiment, recognition rates of full-object images presented for 50msec+masking were equivalent to the rates of MIRCs presented for unlimited time. Our findings indicate that the recognition process at MIRCs level takes hundreds to thousands of milliseconds, which is surprisingly longer than the accepted view that "as soon as you know it is there, you know what it is". What takes the brain so long? One possible explanation is due to eye movements. However, since a MIRC's retinal image falls within the fovea, further re-fixations may be redundant. Alternatively, the increasing recognition rates with increased exposure times suggest that MIRC recognition process requires a sequential top-down process complementing the feed-forward phase.

Acknowledgements: Robin Neustein Artificial Intelligence Fellows Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Please join this conference if you would like to hear more details on this study or have any questions.

Abstract ID: 266

The Effect of Spatial Uncertainty on Visual Efficiency

Poster Presentation - *Topic area: Object Recognition: Processes*

Darshan Thapa[1] (darshan@nyu.edu), Sangita Chakraborty[2], Denis Pelli[1]; [1]New York University, [2]Bronx High School of Science

Intuition suggests that increasing uncertainty (the number of possible options) will make it harder to choose correctly. We compared the effects of uncertainty on human and ideal observers, where the “ideal” makes the maximum likelihood choice. In signal detection theory, efficiency is calculated as the fraction of the energy used by a human that is required by an ideal observer to attain the same performance. Humans identify a gabor or a letter in noise with an efficiency of 3% or 15%, respectively. If introducing spatial uncertainty affects the human and ideal observers differently, then there will be a change in efficiency. We assess this by comparing human vs ideal recognition of fixed-size targets (a gabor of two possible orientations or a Sloan letter of nine possible) in noise at several degrees of spatial uncertainty. Results from 38 observers show that increasing spatial uncertainty from 1 to 104 locations affects efficiency differently for the two tasks. For gabors, efficiency increased by 3.6x from 3.2%±0.5% to 11.6%±2.5%, but for letters the 5.3% efficiency was unchanged due to similar small increases in the thresholds of the human and ideal. This suggests that more complex tasks (with a greater number of more complex objects) are less affected by uncertainty.

Acknowledgements: NIH grant R01 EY027964 to DGP & NYU Dean's Undergraduate Research Fund to DT

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1717

Object Recognition: Reading, emotion, preference

A compositional letter code explains orthographic processing

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Aakash Agrawal[1] (aakash@iisc.ac.in), K.V.S. Hari[2], S.P. Arun[3]; [1]Center for Biosystems Science and Engineering,Indian Institute of Science, [2]Department of Electrical Communication Engineering, Indian Institute of Science, [3]Center for Neuroscience, Indian Institute of Science

Reading is a recent cultural invention that exploits the intrinsic abilities of the visual system to process text. However, the underlying neural mechanism that enables us to read efficiently is unclear. Our ability to read fluently can arise due to the formation of specialized detectors for letter combinations. Alternatively, the representation of words can be more compositional, like the default representation in visual cortex wherein the neural response of an object can be predicted using its part responses. Here, we show evidence for the latter hypothesis by constructing a model in which the response to a string can be predicted using single letter responses. This model is purely visual in nature and does not incorporate any linguistic factors. We tested the performance of this model in predicting human performance in two tasks. The first was visual search, in which subjects had to find an oddball target string embedded among distractors. The second was a lexical decision task, in which subjects had to indicate whether a given string was a word or not. In both tasks, the model was able to predict human performance accurately, without invoking any lexical or linguistic factors. To investigate the underlying neural correlates, we performed measured brain activity using fMRI while subjects performed a lexical decision task. We found that dissimilarities between words and nonwords in visual search corresponded best with neural dissimilarities in the Lateral Occipital region (LO). By contrast, lexical decision times, which were best predicted using word-nonword dissimilarities in the compositional model, were best matched to the overall activation of the Visual Word Form Area (VWFA). Thus, viewing a string of letters activates a compositional code in the higher visual areas, and subsequent decisions about its lexical status are computed in the visual word form area.

Acknowledgements: This research was funded through a Senior Fellowship from the DBT-Wellcome India Alliance (Grant # IA/S/17/1/503081) and the DBT-IISc partnership programme (both to SPA)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1035

Fonts of wider letter shapes improve legibility

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Chiron Oderkerk[1] (code@kadk.dk), Katsumi Minakata[1], Sofie Beier[1]; [1]The Royal Danish Academy of Fine Arts

Designing legible fonts often involves balancing various trade-offs. While the added negative space that surrounds light-weight fonts enhances legibility by mediating the effects of crowding from nearby letters (Dobres, Reimer, & Chahine, 2016), it also impedes legibility at small visual angles by taking up the black space needed for letter recognition at low spatial frequencies (Beier & Oderkerk, 2019). Given the dependence of crowding on visual complexity (Bernard & Chung, 2011) and that stroke frequency has been shown to be a predictor of spatial frequency channels, here, we facilitated letter recognition at small visual angles by increasing the letter width in order to decrease visual complexity by way of the stroke frequency, defined as the number of lines crossed by a horizontal slice through a letter, divided by the width of that letter (Majaj, Pelli, Kurshan, & Palomares, 2002). To investigate the effect of width on letter recognition, we tested three variations of Helvetica (Condensed, Roman, and Expanded). We employed a short exposure single report trigram paradigm in which a string of three letters were presented left or right of the center in the fovea at 1.3° eccentricity. Participants were instructed to report the middle letter while maintaining fixation on the fixation cross. We used an adapted accelerated staircase procedure to determine individual stimulus x-heights and used backward masking to control the exposure duration. A repeated-measures ANOVA indicated a main effect of font width. Bonferroni corrected post hoc t-tests showed that recognition performance decreased significantly with width. Specifically, mean recognition for Roman was significantly higher than for Condensed, while recognition for Expanded was significantly higher than both Roman and Condensed. The findings indicate that wider letter shapes improve reading at small visual angles.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1285

How people experience beauty vs. what philosophers claimed

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Aenne Brielmann[1] (aab689@nyu.edu), Angelica Nuzzo[2], Denis Pelli[1]; [1]New York University, [2]City University of New York

Many philosophers, including Plato, Aristotle, Kant, and Hegel, gave normative definitions of beauty. But do these definitions match how people experience beauty today? And how similar are the felt beauties of

music and images? We presented songs (N = 93) and art- and stock-images (N = 99). For each one, we asked participants to use 7-point scales to rate beauty and 11 further dimensions that philosophers have claimed to be essential to beauty. For images and music alike, beauty ratings were strongly predicted by: pleasure, a wish to continue the experience, feeling free of desire, and thinking that the experience would be beautiful to everyone, all $p < 0.001$. In a further experiment, ratings were high on all of these dimensions (min $M = 5.10$ on a scale of 1 to 7) when independent participants from the US (N = 183), the UK (N = 92), and India (N = 52) rated memories of intense beauty. Other frequently proposed beauty characteristics, like surprise, the need-for-understanding, and mind-wandering were not consistently related to beauty. These results provide a characterization of beauty experiences. They let us test philosophers' claims against the reality of contemporary beauty experiences. For instance, we found support for five of Immanuel Kant's claims (pleasure, being desire-free, universality, a wish for continuation, and no relation to the object's story) but not for another six (free mind-wandering, surprise, feeling alive, a large number of connections with the object, and longing). Plato's and Kant's claims agree with our findings on 5 out of 11 dimensions, Aristotle's on 4, and Hegel's on 3.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Please feel free to reach out to me via email (aab689@nyu.edu) or on twitter (@aabrielma).

If you want to share the presentation and/or poster on Twitter, do add the citation and tag me (@aabrielma) and Denis (@denispelli). Please add the citation to any other shares on different social media platforms.

Abstract ID: 329

Low contrast in letter-stroke facilitates lexical identification

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Katsumi Minakata[1] (kminakata@gmail.com), Chiron Oderkerk[1], Sofie Beier[1]; [1]Royal Danish Academy of Fine Arts Schools of Architecture, Design and Conservation

A long-lasting dispute within typography is whether serif or sans serif fonts are the most legible. However, several parameters affect font legibility; not just whether serifs are present or not. An experiment was conducted to test whether reading performance was more affected by serifs or by the contrast of the font's letter-stroke. We created four fonts, such that their stylistic features were isolated; serifs and letter-stroke

contrast. Type of serif was manipulated to be serif or sans serif, letter-stoke contrast was manipulated to be low or high (i.e., 2 by 2, factorial design), and a lexical decision task was implemented. That is, participants were exposed to a pair of words, one after the other (separate intervals), and one word was always misspelled (swapped two of its middle letters). Participants indicated in which of the two intervals the correctly spelled word was placed (i.e., two-interval, forced-choice task). As a baseline condition, three lexical identification thresholds were obtained via the QUEST algorithm and the font Helvetica. These three thresholds were averaged and used to tailor each participant's stimuli intensities, which were 9 levels of font size. The method of constant stimuli was implemented where the font size varied each trial. There was a main effect of letter-stroke contrast such that low-contrast letter-stroke elicited lower lexical identification thresholds (M = 61.12 points), relative to those elicited by high-contrast letter-stroke (M = 63.49 points), $F(1, 14) = 5.36$, $p = .036$. Neither the main effect of type of serif nor its interaction with letter-stroke contrast were significant, which indicated that the serif parameter did not significantly influence lexical identification. These results lend support for an account through which letter-stroke with low contrast, and not serifs, facilitates observers' lexical identification thresholds.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 369

Preference for curved contours using various presentation times and response measures

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Tomoki Maezawa[1] (porpoise@let.hokudai.ac.jp), Tomoyuki Tanda[1], Jun Kawahara[1]; [1]Hokkaido University

Objects with curved contours are generally preferred to those with angled contours. For example, Bar and Neta (2006) showed participant preferences (like or dislike) with regard to a briefly presented image of a curved or angled object. An important issue is that the strength of this preference varies due to possible confounding factors, such as presentation times and measures to obtain participant responses. It should also be noted that this preference for curvature is evidenced mainly in Western culture populations. In the present study, non-Western observers rated their preferences for real and meaningless objects with curved or angled contours. Stimuli were two types of images (real or meaningless objects) comprising various contours (curved or angled). As control stimuli, real objects comprising a roughly equal mixture of curved and angled features were also included in the set of stimuli. Participants randomly viewed one of the images for 90 ms and decided its preference by a like/dislike rating. The presentation time (90 ms or unlimited presentation time) and the response measure (a like/dislike rating or a 1-100 Likert scale rating) were systematically manipulated across experiments. When using like/dislike ratings, the curvature effects was obtained but only when real object images were presented for 90 ms. Participants did not prefer curved objects when the meaningless objects were presented. There was also an influence of the types of the images (real or meaningless) such that preference for the real images was higher than those for the meaningless objects. Interestingly, the present study demonstrated inverse trends indicating a preference against the curvature effect were observed when the participants used a rating scale as a response measure. The present results suggest that the curvature effects might be situation-dependent potentially due to cultural difference in judgments between Western and non-Western participants.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 667

The Role of Sexual Dimorphism in the Perception of Attractiveness and Confidence

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Anne Thaler[1] (athaler@yorku.ca), Andreas Bieg[2], Naureen Mahmood[3], Michael J. Black[4], Betty J. Mohler[5], Nikolaus F. Troje[1]; [1]York University, [2]Max Planck Institute for Biological Cybernetics, [3]Meshcapade GmbH, [4]Max Planck Institute for Intelligent Systems, [5]Amazon Research, Tuebingen

Human gait patterns are rich in socially relevant information. While many studies have investigated sex-specific differences in walking style, little is known about how sexual dimorphism relates to the perceived attractiveness and confidence of a person. In two studies, 40 observers (20 female, 20 male) rated the attractiveness and another 36 observers (18 female, 18 male) rated the confidence of 50 men and 50 women from the bmlRUB motion capture database, each presented in three different ways in virtual reality: (a) as a 3D virtual character with each actor's individual shape and walking motion reconstructed from optical motion capture data using the MoSh algorithm (Loper et al. 2014, SIGGRAPH Asia), (b) as a static virtual character, and (c) as a walking stick-figure (Troje 2002, JOV). Correlations between all 12 sets of ratings (2 walker sex x 2 participant sex x 3 presentation types) of the two datasets revealed that sexual dimorphism in walking style plays a different role in male and female walkers for attractiveness and confidence ratings. Sexual dimorphism dominates female attractiveness and male confidence assigned to

animated virtual characters and stick-figures. The more feminine a woman walks, the more attractive she is rated; the more masculine a man walks, the more confident he is rated. Perceived male attractiveness and female confidence, on the other hand, are determined by increased vertical body movements which make the walkers appear bouncy and energetic. High ratings of the static virtual characters are characterised by tall and slim body shapes for male and female attractiveness, and female confidence, and tall and strong body shapes for male confidence (as compared to small and heavy body shapes). Sexual dimorphism seems to play a different role in attributing biological and personality traits to male and female walkers, but male and female observers agree on their ratings.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 878

The field of view for word recognition: crowding and hemifield asymmetries

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Alex White[1] (alexander.l.white@gmail.com), Kenny Tang[1], Jason Yeatman[1]; [1]Stanford University

—Background— Written words are unrecognizable outside a small, central region of the visual field (the “field of view”). Common explanations include a drop in acuity and increase in crowding. We hypothesize that the field of view is also determined by factors specific to reading. For instance, words are easier to recognize in the right than left hemifield. One explanation for the hemifield asymmetry is the lateralization of the brain’s reading circuitry to the left hemisphere. —Methods— We measured word recognition accuracy in a lexical decision task as a function of stimulus position along the horizontal meridian, from 6° left to 6° right. We also developed a “flanked gap task” with strings of shapes matched in size and spacing to the words. One of the inner shapes had a gap in the top or bottom. The subject reported which side had the gap. Finally, in the “unflanked gap task,” the target shape appeared alone with no flankers. —Results— Accuracy in the unflanked gap task was consistently near ceiling, demonstrating that acuity was not a limiting factor. In contrast, accuracy in the flanked gap and lexical decision tasks fell off rapidly with eccentricity. The eccentricity effect was highly correlated across the two tasks (mean r=0.87), suggesting that common mechanisms (i.e., crowding) impair both types of shape recognition. However, the two tasks differed in that lexical decision accuracy was better in the right than left hemifield. The hemifield asymmetry suggests that reading is constrained by domain-specific neural mechanisms. Indeed, the

behavioral data match the asymmetric field of view of word-selective visual cortex (the "visual word form area"), measured as the aggregation of its population receptive fields. —Conclusion— The field of view for words cannot be fully accounted for by general visual mechanisms and may depend on the spatial tuning of word-selective cortex.

Acknowledgements: Funding from grants NEI K99EY029366, NICHD R01HD09586101, and NICHD R21HD092771.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Thanks for coming to my poster! I'd love feedback on how to improve the analyses or connect this work to existing literature.

Also, next year I will be starting a new vision lab at Barnard College in NYC. I'll be looking to hire a lab manager and a postdoc. Please reach out if you or someone you know would be interested in joining me!

Abstract ID: 911

The monetary value of pleasure is independent of object kind

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Ashley Feng[1] (acf500@nyu.edu), Aenne Brielmann[1], Denis Pelli[1]; [1]New York University

For Bentham (1781), pleasure is the only value that matters. To test this, we used an auction task to measure the monetary value of three different kinds of object: postcards, snacks, and money lotteries. Undergraduate students bid up to $4.00 on each item. They also viewed each stimulus and rated how much pleasure they felt from it on a scale of 1 to 7. At the end of the session, observers received any unspent money and the objects that they bid for successfully. We find that the relationship between dollar value and pleasure is conserved across object kind. Across all object kinds, a 1-point increase in pleasure corresponded to a $0.24±0.03 ($\beta$ ± SE) increase in value, averaged across observers. That point value (averaged across kind) varied greatly across observers (0.26±0.13), but was conserved across object kinds (AIC difference between models with versus without object-kind-interaction: 2.7, $p = 0.262$). These results support Bentham's conjecture that value is just pleasure.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 779

The simple and the beautiful: An aesthetic preference for medially complex stimuli

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Zekun Sun[1] (zekun@jhu.edu), Chaz Firestone[1]; [1]Johns Hopkins University

A plain, blank canvas doesn't look very beautiful; to make it aesthetically appealing requires adding structure and complexity. But how much structure is best? In other words, what is the relationship between beauty and complexity? It has long been hypothesized that complexity and beauty meet at a "sweet spot", such that the most beautiful images are neither too simple nor too complex. Here, we explore this connection experimentally, by taking advantage of an information-theoretic approach to shape representation. We algorithmically generated a library of smooth 2D polygons, and determined their complexity by computing the cumulative surprisal of their internal skeletal structure — essentially quantifying the amount of information in the object. We then stylized these shapes as "paintings" by rendering them with artistic strokes, and "mounted" them on framed canvases hung in a virtual room. Subjects were shown pairs of these mounted shapes (which varied in their skeletal complexity), and were asked to choose which shape looked best in a given room (by previewing how each painting appeared on the wall). Remarkably, subjects preferred paintings that were neither too simple or too complex, such that moderately complex shapes were chosen as the most attractive paintings. Follow-up experiments generalized this result to a variety of different rooms (such as a kitchen, exhibit hall, or bedroom) and canvases (including different sizes and aspect-ratios). These results suggest a quadratic relationship between aesthetics and visual complexity, and demonstrate the utility of information theory for exploring for exploring surprisingly high-level aspects of our visual experience.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 897

Why are you reading this? Predicting reading goal and familiarity from people's mobile interaction behaviors

Poster Presentation - *Topic area: Object Recognition: Reading, emotion, preference*

Sungjin Nam[1] (sjnam@umich.edu), Zoya Bylinskii[2], Christopher Tensmeyer[2], Rajiv Jain[2], Curtis Wigington[2], Tong Sun[2]; [1]University of Michigan, [2]Adobe Research

People read for different reasons and in different contexts. The reading behavior of a paralegal skimming a contract for specific legal phrases will look quite different than that of a student learning about unfamiliar concepts from a textbook. While the reading of printed material is still commonplace, reading in a mobile context is becoming increasingly popular. From an experimental perspective, mobile devices provide an effective platform for capturing behavioral data outside the laboratory, non-invasively and at scale. In this work, we study reading on mobile devices while measuring readers' attention and behavior without the use of equipment like eye trackers. Specifically, we measure the effects of reading goal and familiarity on the mobile interaction behaviors (touch, scroll, reading time) of 285 crowdsourced (Mechanical Turk) participants reading approximately 500-word articles on mobile devices. We manipulated the familiarity condition by exposing participants to article summaries during a training phase, either related or unrelated to articles that they read during the main study. We manipulated the reading goal by changing instructions participants received, to encourage either 'literal' or 'contextual' reading. Our findings suggest that features based on touch locations can be used to distinguish between familiarity conditions, while scroll-based features and reading time can be used to differentiate reading goal conditions. We also built statistical models that, for a given participant, predict the familiarity level (55.6%) and reading goal (70.2%) with greater accuracy than a baseline model (51.1% (n.s.) and 51.7% ($p<0.001$), respectively). Moreover, individual differences in scrolling behaviors on a mobile device during reading affect the prediction of reading goals when using scrolling speed and idle time as features. The results of our studies motivate promising future investigations of reading on mobile, towards building predictive models of individual readers, as building blocks for customized reading experiences.

Acknowledgements: This work was funded as a part of an internship work at Adobe Research

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The full manuscript of this study can be found at https://arxiv.org/pdf/2004.12016.pdf .

Abstract ID: 951

Perceiving in 3D

Head jitter enhances motion-in-depth perception

Talk Presentation - *Topic area: Perceiving in 3D*

Jacqueline M. Fulvio[1] (jacqueline.fulvio@wisc.edu), Bas Rokers[2]; [1]University of Wisconsin - Madison, [2]New York University - Abu Dhabi

Motion-in-depth perception relies on multiple sensory cues. Previous work has quantified the contribution of binocular motion cues, i.e. interocular velocity differences and changing disparities over time, as well as monocular motion cues, i.e. size and density changes. However, even when these cues are presented in concert, observers will systematically misreport the direction of motion-in-depth stimuli. Here we considered the potential role of small involuntary head movements, i.e. head jitter, in motion-in-depth perception. We first measured head jitter under fixating but head-free viewing conditions. Spectral densities for all three head movement axes exhibited a pink (1/f) noise pattern, consistent with random drift, rather than voluntary control. Head translations and rotations were ~12 mm/s and ~2.5 deg/s on average, respectively. While small, the resulting retinal motion signals were above perceptual threshold. We subsequently investigated the impact of head-jitter on motion-in-depth perception using virtual reality. Observers reported motion-in-depth of a 3D target under head-free viewing while head tracking was on, off, or delayed either randomly or uniformly. Providing head-jitter-induced retinal signals ("on") increased sensitivity and reduced bias of motion-in-depth perception. Increasing random variability in head-movement-to-photon latency ("delayed") reduced sensitivity and produced biases comparable to when head tracking was turned off altogether. Furthermore, uniform delays in motion-to-photon latency also reduced performance. Thus the retinal signals produced by head jitter enhanced motion-in-depth perception, provided that they were (1) consistent, and (2) low-latency. These results suggest that head-restrained viewing typical in psychophysical experiments eliminates cues critical to motion-in-depth perception and underestimates perceptual sensitivity. Similarly, in addition to the well-established role of monocular and binocular motion cues, other cues rarely considered in traditional motion perception experiments, such as accommodative blur and lighting may serve critical roles in the accurate perception of motion-in-depth.

Acknowledgements: Facebook Reality and Google Daydream

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Welcome! Thank you for stopping by. Please feel free to join our Zoom sessions to chat with us directly, or contact us via email with any comments or questions.
Jacqueline Fulvio: jacqueline.fulvio@wisc.edu
Bas Rokers: rokers@nyu.edu

Abstract ID: 391

Measuring the contribution of binocular cues to the perception of 3D object shape

Talk Presentation - *Topic area: Perceiving in 3D*

Rebecca E. Ranson[1] (rjohnse@essex.ac.uk), Paul B. Hibbard[1]; [1]Essex University

3D shape perception depends on multiple cues, which can be weighted according to their reliability in order to provide statistically optimal estimates of depth (Trommershauser et al. 2011). Typical psychophysical tests of optimal cue combination seek to isolate two cues, and vary their relative reliabilities. This allows us to measure their relative weightings (Hillis et al., 2004) and how these vary with changes in the reliability of each cue (Keefe et al., 2011). In typical natural scenes, many cues will be available, and the weighting of each cue will depend on both the availability and reliability of all other cues. The current study measured the weighting of binocular cues in naturalistic scenes in which multiple cues, such as perspective, texture and shading, also contributed to the perception of depth. Observers were presented with a single object which had been 3D scanned and rendered at two distances of 50 and 96cm. We manipulated the effective depth from binocular cues by varying the simulated interocular distance between 0 and 2 times that of each observer. A 'pushpin' gauge figure was presented monocularly at multiple points on the object, and its slant and tilt were adjusted so that it appeared to lie flat on the surface. The best-fitting surface mesh was calculated. Slant and tilt settings were highly correlated with the ground-truth values calculated from the object scan. At the near distance, the depth range specified by observers' slant and tilt settings increased with the simulated IOD with a gain of 9%. At the far distance, there was no change in the perceived depth range with simulated IOD. These results show a modest but reliable contribution of binocular cues to the perception of surface shape for near objects. As predicted from geometrical considerations, this contribution reduced as the distance to the object increased.

Acknowledgements: Leverhulme Trust Research Project Grant RPG-2016-361

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for joining me for my talk. Please feel free to contact me on rjohnse@essex.ac.uk

Abstract ID: 1114

Mental geometry of 3D size estimation in obliquely viewed pictures.

Talk Presentation - *Topic area: Perceiving in 3D*

Akihito Maruya[1] (user3098@sunyopt.edu), Qasim Zaidi[2]; [1]State University of New York, College of Optometry

A 3D object seen from different views, forms quite different retinal images. There exists a single viewpoint from which a photograph forms the same retinal image as the physical 3D scene, but other viewpoints generate distorted retinal images of the scene. Koch et al (PNAS 2018) showed that humans are almost perfect at estimating 3D poses in real scenes by using the optimal geometrical back-transform from retinal orientation to 3D pose, albeit with a systematic fronto-parallel bias. In oblique views of pictures, the scene is perceived as rigidly rotated to the observer's viewpoint, consistent with their using the same observer-centered back-transform as for real scenes. However, oblique views do lead to changes in perceived shape and sizes. We showed previously (VSS 2019) that size inconstancy is perceived in 3D scenes despite observers using the correct geometric back-transform, if the retinal image evokes a misestimate of viewing elevation. Now we examine 3D size estimation in oblique views of pictures. We presented 4 different oblique views of pictures of 3 sizes of rectangular parallelepipeds lying on the ground in 16 poses each. 6 observers adjusted the height of a view-invariant orthogonally attached narrow cylinder to equate the physical lengths of the two limbs. 3D sizes at fronto-parallel poses were seriously underestimated in oblique views compared to the frontal view. By contrast, there was almost no change for objects perceived as pointing to or from the viewer. Observers' corrections for size, as a function of pose, were modeled with the optimal geometric back-transform, subject to a systematic underestimation of the tilt of the display, which was confirmed by perceived display tilt measurements. The excellent fit of the model shows that observers use the back-transform from projective geometry, but underestimate the tilt of the display, similar to the fronto-parallel bias for object pose perception.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
21 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 290

Modeling biases of perceived slant in curved surfaces

Talk Presentation - *Topic area: Perceiving in 3D*

Jonathan Tong[1] (tongj86@yorku.ca), Robert Allison[1], Laurie Wilcox[1]; [1]York University

Veridical perception of surface slant is important to everyday tasks such as traversing terrain and interacting with or placing objects on surfaces. However, natural surfaces contain higher-order depth variation, or curvature, which may impact how slant is perceived. We propose a computational model which predicts that curvature, real or distortion-induced, biases the perception of surface slant. The model is based on the perspective projection of surfaces to form “retinal images” containing monocular and binocular texture cues (gradients) for slant estimation. Curvature was either intrinsic to the modelled surface or induced by non-uniform magnification i.e. radial distortion (typical in wide-angle lenses and head-mounted display optics). The resulting binocular and monocular texture gradients derived from these conditions make specific predictions regarding perceived surface slant. In a series of psychophysical experiments we tested these predictions using slant discrimination and magnitude estimation tasks. Our results confirm that local slant estimation is biased in a manner consistent with apparent surface curvature. Further we show that for concave surfaces, irrespective of whether curvature is intrinsic or distortion-induced, there is a net underestimation of global surface slant. Somewhat surprisingly, we also find that the observed biases in global slant are driven largely by the texture gradients and not by the concurrent changes in binocular disparity. This is due to vertical asymmetry in texture gradients of curved surfaces with overall slant. Our results show that while there is a potentially complex interaction between surface curvature and slant perception, much of the perceptual data can be predicted by a relatively simple model based on perspective projection. The work highlights the importance of evaluating the impact of higher-order variations on perceived surface attitude, particularly in virtual environments in which curvature may be intrinsic or caused by optical distortion.

Acknowledgements: This work was funded by an NSERC Collaborative Research & Development (CRD) grant, in partnership with Qualcomm Canada Inc, and the Canada First Research Excellence Fund (CFREF) for the Vision: Science to Application (VISTA) program.

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 561

Perception of Nonrigid Change in 3D Shape While Walking in A Virtual Environment

Talk Presentation - *Topic area: Perceiving in 3D*

Ying Yu[1] (yu.1416@osu.edu), James T Todd[1], Jian Chen[1], Alexander A Petrov[1]; [1]The Ohio State University

Yu et al. (2018, doi: 10.1167/18.10.720) showed that the apparent shape of a 3D object depended on viewing distance: Far objects appear compressed in depth compared to near ones. The present experiment investigates how well people can notice this perceptual distortion when the viewing distance is changing due to either object-motion or self-motion. Method: The virtual-reality stimuli were presented on a HTC Vive head-mounted display. On each trial, participants saw two side-by-side polyhedral objects, similar to the stimuli of Yu et al. (2018), floating at eye level within a virtual room. In the object-moving condition, both objects moved synchronously back and forth relative to a stationary observer. In the participant-moving condition, participants walked back and forth relative to the static objects. In either condition, one of the objects was systematically stretching or compressing in depth, whereas the other object remained rigid. The task was to identify the nonrigid object. Both nonrigid deformation and rigid motion occurred along the line from the object's to the participant's current locations. The amount of deformation was a linear function of viewing distance. The slope of this function (or rate of nonrigidity) was manipulated by staircase procedures. Rate=0 produced a rigid object. Positive or negative rate produced a nonrigid object that stretched or compressed in depth, respectively, as distance increased. The 75%-correct threshold was estimated by psychometric-function fit. Results: Data from 3 participants showed that the deformation-discrimination threshold was higher for the positive rates than for the negative rates in both conditions, meaning that deforming that compensating the previously found distance-dependent shape distortion was harder to detect than the deforming exaggerating this distortion. Moreover, the threshold was lower in the participant-moving than in the object-moving condition, suggesting the importance of self-motion in detecting nonrigidity.

This talk will be presented in Live Talk Session 3, Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1676

Scene-relative object motion biases depth percepts based on motion parallax

Talk Presentation - *Topic area: Perceiving in 3D*

Ranran French[1], Gregory DeAngelis[1]; [1]University of Rochester

An important function of the visual system is to represent the 3D structure of the world from the sequence of 2D images projected onto the retinae. During observer translation, relative image motion between stationary objects at different distances (motion parallax, MP) provides potent depth information. However, if an object is moving relative to the scene, this complicates the computation of depth from MP since there will be an additional component of image motion related to object motion. To correctly compute depth from MP, this component should be ignored by the brain. Previous experimental and theoretical work on depth perception from MP has assumed that objects are stationary in the world. How the brain perceives depth of moving objects based on motion parallax has not been examined. Naïve human subjects viewed a virtual 3D scene consisting of a ground plane and stationary background objects, while lateral self-motion was simulated by optic flow. A target object, lying above the ground plane, could be either stationary or moving laterally at different velocities. Subjects were asked to judge the depth of the target object relative to the plane of fixation. Subjects showed systematic biases in perceived depth that depend on object velocity, with larger biases during monocular presentation of the target object. We consider two possible sources for this bias. First, if the brain computes depth by parsing retinal image motion into components related to self-motion and object motion, then incomplete flow parsing should result in inaccurate depth estimates. Second, uncertainty regarding whether or not the object is moving in the world may affect the brain's ability to isolate image motion caused by self-motion. Future work will evaluate whether these two possible explanations account for our observations. Our findings establish that perception of depth from MP does not compensate for object motion.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
21 June, 6:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter can be reached through email at ranran_french@urmc.rochester.edu.

Abstract ID: 569

Perception and Action: Affordances

A Day at the Beach: Does the energy cost of walking influence visually perceived distance?

Poster Presentation - *Topic area: Perception and Action: Affordances*

Brittany A. Baxter[1] (brittany_baxter@brown.edu), William H. Warren[1]; [1]Brown University

It takes less effort to walk from here to the Tiki Hut on the brick walkway than on the sandy beach. Does that influence how far away the Tiki Hut looks? Last year at VSS we ran the experiment to find out. The energy cost of walking on dry sand is twice that of walking on firm ground (Lejeune, et al., 1998). If distance is perceived in units of energetic cost or 'behavioural potential' (Proffitt, 2006), then visual distances over sand should be double those over brick. If distance is perceived in constant units (e.g. eye-heights as specified by declination angle; Ooi, et al., 2001), then the visual distances should be similar. Participants (N=13) viewed a target at a distance of 5, 7, 9, or 11m over sand or brick, were blindfolded and turned toward the same or different terrain, then blind-walked to match the visual distance. Walked Distance was analyzed using mixed effects regression with Target Distance, Viewed Terrain, and Walked Terrain as fixed-effect predictors. The energetic hypothesis predicts that walked distance should be greater after viewing over sand than over brick. But walked distance was actually shorter after viewing over sand ($\beta = -0.59$, SE = 0.21, $\chi2(1) = 6.05$, $p = 0.01$). There was no difference between walked distance on sand and brick ($p = 0.71$), with moderate evidence for the null hypothesis (BFJZS = 3.38). Thus, perceived distance did not increase with the energy cost of the viewed terrain. Moreover, walked distance was no different on sand and brick, indicating an accurate locomotor calibration to each terrain. The results imply that distance is not perceived in terms of energetic cost. Rather, visually perceived distance is constant, and walking is guided by a visual-locomotor mapping (e.g. from declination angle to locomotor distance on the terrain) (Warren, 2019).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 512

Action embodiment of expert athletes within familiar and unfamiliar sporting contexts

Poster Presentation - *Topic area: Perception and Action: Affordances*

I sak Kim[1] (isak@hawaii.edu), Scott Sinnett[1], Nicola Hodges[2], Alan Kingstone[2]; [1]University of Hawaii at Manoa, [2]University of British Columbia

Embodied cognition refers to the idea that action and body experience can influence the mind and how humans pay attention to and perceive environmental stimuli. For example, when responding to some dimension/characteristic (e.g., color) of a teacup using the right-hand, faster responses are observed when the handle faces to the right, presumably due to premotor cortex preparation to grasp the virtual cup. Other research has extended this to conditions where participants responded to images of expert athletes who play a sport-related to either hand (i.e., tennis) or foot (i.e., soccer) effectors (Bach & Tipper, 2006). However, the finding was the opposite, with compatible response-sport matchings resulting in slower response times than incompatible conditions, even without any displayed overt action, arguably due to an inhibitory social contrast effect. With the questionable replicability of the social contrast (Doyen et al., 2012), we explored whether simply viewing an expert soccer/tennis player both in and out-of-action would lead to a similar effect. We further examined how the effect might be modulated by creating conditions where the images portrayed the expert athletes playing the opposite sport (e.g., Roger Federer playing soccer) to determine whether an action or identity-response compatibility drives the effect. The findings indicated that participants responded more quickly with the effector that matched the sporting-action in both congruent-contexts (e.g., hand-response to Federer playing tennis) and incongruent-contexts (e.g., foot-response to Federer playing soccer). The data highlight that despite the identify discrimination task, response times were facilitated by the perceived action even for pictures where the identity should facilitate the opposite response. Meaning, while the context manipulation did interfere with participants' motor response associated with the player identity (i.e., slower overall), responses were faster for effectors associated with the portrayed action rather than the player's identity.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 979

Effect of effort on perceived geometry

Poster Presentation - *Topic area: Perception and Action: Affordances*

Balagopal Raveendranath[1] (braveen@clemson.edu), Narayanan Srinivasan[1]; [1]Centre of Behavioural and Cognitive Sciences

Different geometries are used to model perceived psychological space. Affine geometry is one such model which can be used to understand how we map physical space to perceived space. In such affine transformations, properties like coplanarity of points, parallelism of a pair of lines and ratio of lengths of line segments in the same direction, remain invariant. One approach to study such a visual space is to consider its intrinsic structure, that is, how the spatial judgments that people make, relate to each other. According to action-specific approach to perception, perceived distance to targets is scaled by effort required to walk that extent. In this experiment, we tested whether effort required to walk affected the intrinsic structure of perceived space, by using Varignon's theorem. According to Varignon's theorem, if we join the bisection points of the four edges of an arbitrary quadrilateral, it forms a parallelogram in affine space. Also, bisection points of the line joining bisections of opposite edges will coincide with each other in the case of an intrinsically consistent affine structure. Here, for half of the participants, we manipulated their effort required to walk, by using a treadmill. The participants were shown two adjacent vertices of a quadrilateral in each trial and were asked to blind-walk to the midpoint. They also performed bisection judgments of the bisections of opposite edges in the last two trials and we checked the distance between these two final points for intrinsic consistency. Although we did not find a significant effect of required effort on the intrinsic consistency of perceived affine space, we observed a trend that there was more distortion when effort required to walk was manipulated using a treadmill. The results suggest that perceived space might be affected by effort required to act on physical space.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1584

Effect of footedness on valence-space associations

Poster Presentation - *Topic area: Perception and Action: Affordances*

Mallory Weber[1] (mweber2@css.edu), Hsin-Mei Sun[1]; [1]College of Saint Scholastica

According to the body-specificity hypothesis (Casasanto, 2009), people implicitly associate positive/negative valence with their dominant/non-dominant side. For example, right-handers tend to

associate “good” with “right” and “bad” with “left,” whereas left-handers show the opposite pattern, associating “bad” with “right” and “good” with “left.” Such valence-space associations cannot be attributed to linguistic or cultural experience but rather to body-specific preferences (Casasanto, 2009). The present study aimed to extend previous research by investigating how foot preference affects the associations between valence and left-right foot space. Participants performed two simple motor tasks in which they used their hand (Task 1) and foot (Task 2) to move a monster cutout to one of the two boxes located to the left and right of a cartoon figure. Participants were told that the cartoon figure likes certain monsters and thinks they are good but dislikes other monsters and thinks they are bad. Additionally, participants were instructed to move the good monster to the box they thought best represented good things and the bad monster in the box that best represented bad things. The assignment of valence to different monsters and the order of tasks were counterbalanced across participants. In line with previous findings, our results showed that a majority (74%) of right-handers (N = 42) assigned the good monster to the right box in the hand task. Additionally, a majority (72%) of right-footers (N = 25) assigned the good monster to the right box in the foot task. However, the association of valence and left-right foot space was weak in participants with no foot preference (N = 17), with 58% of these participants moving the good monster to the right box using their foot. In sum, our results demonstrate an association between the dominant/non-dominant foot and positive/negative valence, supporting the body-specificity hypothesis.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 575

Hybrid versus unified accounts of affordance perception and on-line control during locomotor interception

Poster Presentation - *Topic area: Perception and Action: Affordances*

Grace Roessling[1] (grace.roessling19@gmail.com), Brett Fajen[1]; [1]Rensselaer Polytechnic Institute

Most real-world locomotor interception tasks involve both affordance perception and on-line visual regulation. Affordance perception is critical for knowing whether a moving target is catchable and worth pursuing. Fajen (2013) proposed that the perception of catchability relies on “affordance-based information” about the speed needed to intercept in relation to one’s maximum possible speed. Visual regulation entails continuous, on-line guidance of locomotor speed and direction. According to most accounts, actors rely on so-called “current-future information” such as the change in bearing angle, which specifies whether one will intercept the target in the future if current conditions persist. Taken together, this implies a hybrid account of locomotor interception according to which the perception of catchability and on-line visual guidance are treated as separate processes that rely on different sources of information. The aim of this study was to explore through modeling and simulation the behavior that emerges from such a hybrid strategy in the context of a complex locomotor interception task. We used Matlab to create a model of this strategy and simulated it for a task that required the agent to both accurately perceive whether targets were catchable and regulate speed and direction of locomotion to intercept targets. We also modeled an alternative unified strategy that relies entirely on affordance-based information for both pursuit decisions and on-line guidance. By this account, the agent pursues catchable targets by moving in a direction that allows for interception while traveling as close as possible to its preferred speed. The behavior that emerged from both strategies was compared to that exhibited by human subjects performing the same task. We demonstrate that a hybrid strategy that relies entirely on current-future information after movement initiation cannot account for behavior and that affordance perception plays a role in both pursuit decisions and on-line visual guidance.

Acknowledgements: ONR N000141812283

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

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Youtube Link to Video: https://cutt.ly/wy6ntdS

Abstract ID: 1299

Judgments of Passing Through Augmented Reality Apertures: The Role of Viewing Distance and Feedback

Poster Presentation - *Topic area: Perception and Action: Affordances*

Holly Gagnon[1] (holly.gagnon@psych.utah.edu), Dun Na[2], Keith Heiner[1], Jeanine Stefanucci[1], Sarah Creem-Regehr[1], Bobby Bodenheimer[2]; [1]University of Utah, [2]Vanderbilt University

Augmented reality (AR) is increasingly being used for spatial applications, such as navigation and training procedures. Accurate perception of action capabilities, or affordances, in AR is critical for the effectiveness of these applications. Initial research suggests that affordances in AR are perceived similarly to the real world, but the role of restricted field of view (FOV) inherent in AR devices and feedback about affordance judgment accuracy have not been addressed. In the present study, participants made judgments about passing through an AR aperture defined by two virtual walls presented via a Microsoft HoloLens. First, we investigated whether affordance judgments were affected by viewing distance. We hypothesized that judgments would be impaired when viewing at a close distance because the entirety of the aperture was not visible within the FOV of the HoloLens. To test this hypothesis, participants viewed the aperture from a near (0.85 m) or far (3.20 m) distance. Second, we explored whether verbal feedback on judgment accuracy would improve judgments over time. To assess this question, we asked participants to adjust the virtual walls until they resembled the smallest passable aperture. Following that, they were presented with an aperture and asked to judge whether the aperture was passable and then received verbal feedback. Then they performed the adjustment task again to estimate the smallest passable aperture followed by more feedback. Results indicate that passing through judgments were closer to actual shoulder width when viewed at a distance near the aperture compared to the far viewing distance, contrary to our prediction. Verbal feedback reduced error over trials at the farther distance but not the near distance, possibly because near distance judgments were close to ceiling performance. Our results provide a promising way to reduce error in affordance judgments in AR, but also open questions about generalizability to other tasks.

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Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

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This work was also published in Proceedings of the 2020 IEEE Conference on Virtual Reality and 3D User Interfaces. https://ieeexplore.ieee.org/abstract/document/9089552

Abstract ID: 262

Object stability is determined by the geometric centroid

Poster Presentation - *Topic area: Perception and Action: Affordances*

Yaxin Liu[1] (yliu668@emory.edu), Stella Lourenco[1]; [1]Emory University

Humans are remarkably adept at intuiting whether an object will fall or not. Adults, and even infants, judge object stability across various physical scenarios. Yet the computations involved in making such judgments remain poorly understood. Much research has focused on model-based simulation approaches (e.g., Battaglia, Hamrick, & Tenenbaum, 2013), but the perceptual primitives required as input to such models have been relatively unexplored. Here we tested whether the geometric centroid of objects plays a role in stability judgments. In three experiments, children (ages: 5 to 7 years) and adults (college students) judged the direction of falling for an unstable object. The Point of Subjective Equality (PSE)—the critical angle at which the object is equally likely to fall to either side—was modeled for each object. In Experiment 1, participants judged stability for objects of different aspect ratios. Participants' PSEs scaled according to the centroids of the objects. However, because height and base size also differed across objects, these cues, not the centroid, may have allowed for judging stability. In Experiment 2, we equated base size across objects to rule out the exclusive use of this cue. Nevertheless, participants' PSEs varied across objects, suggesting that the centroid (or height) of the objects was used for judging stability. In Experiment 3, we used objects that differed in height (identical base size and centroid) and we found no difference in participant's PSEs, consistent with participants judging stability via the centroids. Moreover, even when objects differed only slightly in their centroids, adults', but not children's, PSEs for the objects differed, suggesting a developmental difference in the precision of the estimated centroid for object stability judgments. Taken together, our results demonstrate a perceptual mechanism underlying physical judgments that improves in precision across development.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1508

Proprioception and hand visualization distort the affordance of reaching

Poster Presentation - *Topic area: Perception and Action: Affordances*

Ashley Funkhouser[1] (ashley.funkhouser@usm.edu), Alen Hajnal[1]; [1]The University of Southern Mississippi

Past research demonstrated that distance perception is less accurate in virtual reality environments (Loomis & Knapp, 2003) than in the real world. In real life, actions improve accuracy in reaching judgements (Bootsma, 1989; Oudejans, Michaels, Bakker, & Dolné, 1996). Avatars aid in accuracy involving distance

judgements in virtual reality (Mohler, Creem-Regehr, Thompson, & Bülthoff, 2010; Lin, Rieser, & Bodenheimer, 2015). The present study sought to test if action in conjunction with an avatar's presence will improve reachability judgement in VR. A virtual ball was placed at eye level at different egocentric distances. The task was to perceive whether the ball is within reach. Condition 1 was perception-only, where the participant was not allowed to move nor could see their arms. Condition 2 was perception with nonvisible action, where the participant could move their real arm to reach but could not see an avatar of the arm. Condition 3 was perception with visible action, where the participant could move and see a virtual hand that corresponded to the actual arm movement. By employing both perception and action Condition 3 was expected to have the highest accuracy and fastest response time due to its superior ecological validity, followed by Condition 2 and Condition 1. There were 25 participants ran per condition, for 75 participants total. Participants reported distances as reachable that were beyond their arm length by about 15% in the avatar condition and the proprioceptive condition, followed by the perception-only condition which was the most accurate (around 5% overestimation). Response times were comparable for distances within reach, but got longer in Conditions 2 and 3 when the ball was out of reach. Our results point to the lack of expected haptic feedback as a critical variable that may have caused distortion in the avatar action condition.

Acknowledgements: Psi Chi, University of Southern Mississippi's Eagle Scholar Program for Undergraduate Research Grant (SPUR)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1182

Small arms weapon use influences distance estimation

Poster Presentation - *Topic area: Perception and Action: Affordances*

Aaron L. Gardony[1,2] (agardony@centerforabcs.org), Carlene A. Horner[2]; [1]US Army CCDC Soldier Center, [2]Center for Applied Brain and Cognitive Sciences, Tufts University

Using tools (e.g. a stick) to interact with (e.g. reaching) faraway objects compresses distance estimation (Witt & Proffitt, 2008), an effect that persists with remote interaction (i.e. using a laser pointer; Davoli, Brockmole, & Witt, 2012). Relevant to the US Army, small arms weapons are tools that permit remote interaction with (e.g. shooting) and passive viewing (e.g. sighting) of distant targets. Does using a gun influence distance estimation compared to a non-lethal tool (e.g. a range finder)? Does the tool's effective

range or the interaction used (e.g. shooting vs. sighting) matter? The present study investigated these research questions. Soldiers completed a distance estimation task in head-mounted virtual reality. On each trial, participants saw a distant target [range: 3-27m]. We manipulated the tool used (a pistol vs. a range finder), the interaction engaged in (shoot the target vs. sight it), and the effective range of the tool (long vs. short) in a fully counterbalanced, within-participants design. We observed distance overestimation overall which decreased linearly as a function of target distance. Distance estimate compression was greater for sighting vs. shooting, which was enhanced by gun use and long range tools. The results suggest that sighting a distant target with a weapon compresses distance estimates, compared to a non-lethal tool.

Acknowledgements: The opinions expressed herein are those of the authors and do not reflect those of the United States Army. This research was supported by the U.S. Army Combat Capabilities Development Command Soldier Center (CCDC SC, Natick, Massachusetts, USA). The authors have no conflicts of interest to declare.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 187

Where the Action Could Be: Speakers Look at Graspable Objects and Meaningful Scene Regions when Describing Potential Actions

Poster Presentation - *Topic area: Perception and Action: Affordances*

Gwendolyn Rehrig[1] (glrehrig@ucdavis.edu), Candace E. Peacock[1], Taylor R. Hayes[1], John M. Henderson[1], Fernanda Ferreira[1]; [1]University of California, Davis

The world around us is visually complex, yet we can efficiently describe it by extracting the information that is most relevant to convey. How do the properties of a real-world scene help us decide where to look and what to say about it? Image salience has been the dominant explanation for what drives visual attention and production as we describe what we see, but new evidence shows scene meaning predicts attention better than image salience. Another potentially important property is graspability, or the possible grasping interactions objects in the scene afford, given that affordances have been implicated in both visual and language processing. We quantified image salience, meaning, and graspability for real-world scenes. In three eyetracking experiments (N=30,40,40), native speakers described possible actions that could be carried out in a scene. We hypothesized that graspability would be task-relevant and therefore would

preferentially guide attention. In two experiments using stimuli from a previous study (Henderson & Hayes, 2017) that were not controlled for camera angle or reachability, meaning explained visual attention better than either graspability or image salience did, and graspability explained attention better than salience. In a third experiment we quantified salience, meaning, graspability, and reachability for a new set of scenes that were explicitly controlled for reachability (i.e., reachable spaces containing graspable objects). In contrast with our results using previous stimuli, we found that graspability and meaning explained attention equally well, and both explained attention better than image salience. We conclude that speakers use object graspability to allocate attention to plan descriptions when scenes depict graspable objects that are within reach, and otherwise rely more on general meaning. Taken as a whole, the three experiments shed light on what aspects of meaning guide attention during scene viewing in language production tasks.

Acknowledgements: Supported by the National Eye Institute of the National Institutes of Health under award number R01EY027792 and National Science Foundation grant BCS-1650888.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The project presented here was published in Journal of Experimental Psychology: Learning, Memory, and Cognition https://psycnet.apa.org/record/2020-24011-001

A preprint is available here: https://psyarxiv.com/6uep5/

You can find the Matlab code to generate feature maps from crowdsourced ratings on the OSF: https://osf.io/654uh/

Abstract ID: 540

Perception and Action: Arm and hand actions

2D and 3D Stimuli Both Generate Stable Digit Placement During a Manipulation Task

Talk Presentation - *Topic area: Perception and Action: Arm and hand actions*

Ryan W. Langridge[1] (langrirw@myumanitoba.ca), Jonathan J. Marotta[1]; [1]Perception and Action Lab, University of Manitoba

Previous research has demonstrated similarities in the locations people view and place their digits when 'grasping' a 2D target or a similarly shaped 3D object. A critical difference between these two actions is the ability to manipulate the 3D object once grasped. This lack of affordance when grasping 2D stimuli may lead to different visuomotor strategies. Using their index finger and thumb, participants grasped either 2D square shapes presented on a computer screen, or identical 3D objects attached to a presentation board. These shapes were located at either central (center of the screen/board) or non-central (leftward or rightward) positions. Participants were instructed to simply grasp the square (Grasp Only), or grasp and slide it to another location (Manipulate). An Optotrak Certus was used to measure placement of the digits, and MotionMonitor software was used to generate the manipulatable on-screen targets. Comparison of the 2D and 3D stimuli revealed similar digit placement – aligned with the square's horizontal midline – when the square was located in the center of the screen/board. When grasping non-central 2D targets, participants favoured 'convenient' grasp locations, closer to the approaching arm. In contrast, when grasping 3D objects, grasps were positioned closer to the horizontal midline – prioritizing stability over convenience. However, the type of task had a similar influence on both 2D and 3D stimuli; when grasping only, digit placement was closer to the nearest edge (biased toward the approaching arm) of non-centrally located squares compared to more stable digit placement during manipulation. Despite the convenient digit placement when grasping 2D targets, the similar visuomotor behaviours observed when grasping and manipulating both types of stimuli suggest participants were treating the 2D targets as 3D objects. Stability was prioritized when manipulation was involved, despite the 2D targets lacking the physical properties requiring them to do so.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for your interest in our presentation. Please find a PDF version of the presentation slides, accompanied by written descriptions in the Supplemental Materials.

If you would like to learn more about our research, please visit our lab website at perceptionandaction.com.

Abstract ID: 940

Causal evidence for parietal lobule dynamics supporting intention readout

Talk Presentation - *Topic area: Perception and Action: Arm and hand actions*

Stefano Panzeri[1] (stefano.panzeri@iit.it), Jean-François Patri[1], Atesh Koul[1], Marco Soriano[1,2], Martina Valente[1,3], Alessio Avenanti[4,5], Andrea Cavallo[1,2], Cristina Becchio[1]; [1]Istituto Italiano di Tecnologia, Genoa and Rovereto, Italy, [2]University of Turin, Turin, Italy, [3]University of Trento, Rovereto, Italy, [4]University of Bologna, Cesena, Italy, [5]Universidad Catolica del Maule, Talca, Chile

The ability to understand other people's intentions by observing their actions is crucial to interpret and anticipate their behavior. However, the specific neural computations involved in this ability remain unclear and causally untested. One major reason is the difficulty of identifying intention readout patterns associated with ever-changing kinematic features. Movement is "repetition without repetition". Statistical analyses averaging across trials can blur away how intention information encoded in single trial variations is readout in real-time. Here we developed a novel approach combining motion tracking with continuous theta burst stimulation (cTBS) and new computational analyses to determine how the transient disruption of a target region – the left inferior parietal lobule (IPL) – influences intention readout computations with single-trial resolution. In separate sessions, participants received neuronavigation-guided cTBS to the left IPL or the left Inferior frontal gyrus (IFG) before completing a two-alternative, forced-choice visual discrimination of intention. Single-trial analyses combined with a set of task manipulations revealed that cTBS to the left IPL, but not to left IFG, selectively impaired the ability to infer the intention of an observed action from variations in visual kinematics. Importantly, IPL cTBS did not interfere with the ability to 'see' changes in movement kinematics, nor did it alter the weight given to informative versus non-informative kinematic features. Rather, it selectively impaired the ability to link variations in informative features to the correct intention. These results support a model in which the selection of the most informative kinematic feature occurs outside of the left IPL and in which the left IPL is selectively responsible for the correct readout of such features.

Acknowledgements: This work received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 754490.

This talk will be presented in Live Talk Session 7, Tuesday, 23 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1098

Is grasping always immune to Weber's law?

Talk Presentation - *Topic area: Perception and Action: Arm and hand actions*

Zoltan Derzsi[1] (zd8@nyu.edu), Robert Volcic[1]; [1]New York University Abu Dhabi

When people reach out and lift an object, the variability of grip aperture, unlike the variability of perceptual estimates, is unaffected by variations in object size. According to the two-visual-systems hypothesis, Weber's law is violated because unlike for perception, visual coding for action is based on absolute metrics. A different hypothesis, which does not assume independent visual coding for perception and action, ascribes the violation mostly to biomechanical factors that affect finger aperture in grasping. Here, we contrast these hypotheses by introducing a task in which the role of biomechanical factors is eliminated, but object size is still a relevant feature. Participants (n = 31) had to either grasp or lift rods of different lengths (13, 24, 35 cm; 1x1 cm cross-section) with the requirement to achieve a balanced lift (grasping task) or simply indicate the rods' center (perceptual task). If the object's length for grasping is computed veridically, as predicted by the two-visual-systems hypothesis, we should find a dissociation between the grasping and the perceptual tasks: the variability in the grasping task should remain constant across objects, and the variability in the perceptual task should increase as a function of object length. Instead, we found that the variability increased with physical length in both the perceptual and the grasping tasks with identical slopes. Interestingly, grasping variability did not improve over successive repetitions even though both haptic and visual feedback about the object orientation was available during lifting. These results demonstrate that Weber's law is at play in both action and perception when length is essential to determine the center of the object and biomechanical factors are eliminated. Thus, these findings have implications for the fundamental assumption of the two-visual-systems hypothesis that action and perception rely on different computations of the visual input.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Since I live one third of a planet away from VSS, I may not respond immediately in the chat. Feel free to send me an email. My email address is in the last slide of the supplementary material.

Abstract ID: 991

Stimulus-locked responses on human upper limb muscles prefer low spatial frequency, high contrast, and fast moving targets

Talk Presentation - *Topic area: Perception and Action: Arm and hand actions*

Rebecca Kozak[1], Brian Corneil[1]; [1]Western University

To reach towards a visible target, such as a coffee mug, visual information has to be transformed into motor commands. Visual information such as the colour, shape, and size of the mug is processed within numerous brain areas, then relayed to the motor periphery. However, in order to catch a falling mug, we must transform vision into action as quickly as possible. These fast visuomotor transformations, and their underlying neurological substrates, are poorly understood in humans. Fundamental questions still remain regarding what visual information is necessary or available to a fast visuomotor system. My presentation will focus on work which attempts to better understand the nature of visual input received by the fast visuomotor system, beginning with a description of stimulus-locked responses (SLRs) which provide a measure to study the fast visuomotor system. SLRs are the first wave of motor recruitment directly influenced by visual stimulus presentation and are hypothesized to be mediated via the Superior Colliculus. To study the effects of visual stimulus attributes on the SLR, human subjects generated visually guided reaches towards stimuli using a robotic manipulandum, as surface electrodes recorded electromyographic (EMG) activity from the pectoralis major muscle. Recently, we have detailed SLRs in response to systematically varied visual parameters including spatial frequency, speed and contrast. Our results suggest that a combination of low spatial frequency, high contrast, and fast moving targets evoke SLRs in all tested participants. These findings may be consistent with preferential magnocellular (M) pathway input into a fast visuomotor system. Importantly, those stimuli that best evoke SLRs are also those that elicit the earliest “mid-flight” corrections during an on-going reaching movement. Detailing the visual stimulus attributes that best evoke SLRs will aid future studies of a fast visuomotor system across the lifespan, and in health and disease.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 554

Perception and Action: Decision making

Effects of motor response pattern on serial dependence in visual confidence

Poster Presentation - *Topic area: Perception and Action: Decision making*

Alan L. F. Lee[1,2] (alan.lf.lee@gmail.com), Ho Fai Law[1], Leo C.H. Ng[1]; [1]Department of Applied Psychology, Lingnan University, Hong Kong, [2]Wofoo Joseph Lee Consulting and Counselling Psychology Research Centre, Lingnan University, Hong Kong

Visual confidence -- the evaluation of one's own performance in a visual task -- demonstrates serial dependence when the visual task is performed over a series of trials. Despite the converging evidence for such serial effects on visual confidence, the underlying mechanisms remain unclear. The present study investigated the effects of motor response pattern on serial dependence in visual confidence using a novel paradigm. In each trial, participants performed a left-right, direction-discrimination task on a random-dot motion pattern. Simultaneously, they rated their confidence by pressing one of the 8 keys (2 directions x 4 points). Task difficulty was manipulated by varying motion coherence, which had been calibrated to individual participant's direction discriminability using adaptive staircase. In the main experiment, we sequenced trials based on their difficulty levels, such that a (target) medium-difficulty trial was preceded by either easy or difficult trials. In Experiment 1, we found that confidence rating in target trials was higher when they were preceded by easy trials than by hard trials, despite matched task performance of the target trials between the two conditions. This suggests that confidence judgments can be biased in a series of tasks. In Experiment 2, we employed the same paradigm but instructed participants to respond either using the keyboard as in Experiment 1 or using the mouse to indicate confidence on one of two (left and right) on-screen, continuous sliders. We found the same serial confidence bias only when mouse was used in both preceding and target trials. Interestingly, using the meta-d' analysis, we found that metacognitive sensitivity was higher when participants switched from mouse (preceding) to keyboard (target). In other words, repeatedly responding in the same motor pattern could impair metacognitive sensitivity. This suggests that the continuity in motor response pattern may contribute in producing serial effects on visual confidence.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Welcome to our poster! If you have any questions, feel free to leave a message in the chat and we'll get back to you. Any feedback/comments will be much appreciated!

Abstract ID: 1153

Electrophysiological Signatures of Confidence in a Perceptual Decision under Performance-controlled Conditions

Poster Presentation - *Topic area: Perception and Action: Decision making*

Lleymi J. Martinez Arango[1], Olenka Graham Castaneda[2], Jason Samaha[1]; [1]University of California, Santa Cruz, [2]University of California, Riverside

Perceptual decisions are thought to arise from the accumulation of sensory evidence towards a decision boundary. Human and animal experiments have found that the rate of evidence accumulation - which reflects the quality of sensory evidence - is informative of accuracy, reaction time, and confidence. However, many experiments have shown that subjective confidence judgments are influenced by factors other than the quality of evidence, and that, accordingly, confidence and performance (accuracy) are readily dissociable. This raises the question of whether neural signatures of evidence accumulation track objective performance or subjective confidence. Observers discriminated the net direction of motion of a random dot kinematogram (RDK) while EEG was recorded. The stimulus was an overlap of two RDKs, one with evidence in favor of a correct decision ("positive evidence"; PE) and the other with a lower amount of counterevidence ("negative evidence"; NE). In separate trials, we increased both the amount of PE and NE by an individually-titrated level that should produce no significant change in discrimination accuracy. According to prior work, higher confidence ratings (made concomitantly with the choice) occur when PE and NE are increased, allowing us to dissociate neural signatures of confidence and accuracy. We observed signals over central parietal electrodes that obey the principles of evidence accumulation. EEG activity beginning around 200 ms post-stimulus increased at a rate that predicts reaction times. Namely, trials with faster responses were associated with a steeper increase in voltage. This activity also tracked confidence ratings, as sharper increases in activity correlated with higher confidence. Interestingly, the same component showed steeper increases in voltage when comparing high to low PE trials, which were associated with higher confidence, but no change in accuracy. This finding suggests signatures of evidence accumulation may underlie the formation of our subjective sense of confidence even when accuracy is controlled.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1323

How complex can the 'shape' of expectations be? Investigating error distributions under skewed priors.

Poster Presentation - *Topic area: Perception and Action: Decision making*

Syaheed B. Jabar[1], Daryl Fougnie[1]; [1]New York University Abu Dhabi

The visual world is full of statistical regularities; stop signs are red and bananas usually are yellow. While such regularities can be quite complex, we tend to study priors that consist of Gaussian distributions. Research has shown that participants are sensitive to the mean and variance of distributions. Here we explore whether people can adapt to more complex distributions, i.e. with skew. To investigate this, we employed a delayed color-matching task where the shape of a trial-by-trial prior (expectation) was visually made available at response. The prior was either symmetrically distributed or had (positive/ negative) skew. Bayesian-like effects (bias towards the prior and reduced error) were observed, suggesting integration of priors. Multiple pieces of evidence point to participants being sensitive to skew. Although unintuitive, Bayesian observer models predict that positively-skewed priors result in negatively-skewed error distributions (and vice-versa), which we observed, ($t(20) = 3.43$, $p = .003$). This skew flip was replicated with a task requiring multiple responses ($t(20) = 2.34$, $p = .030$), and when priors were fixed across blocks, ($t(20) = 2.39$, $p = .027$). Model fits further suggested that 45 out of 63 participants were more likely to have used the skew information, versus approximating the priors as Gaussians. To demonstrate this behaviorally, we compared providing additional participants ($n = 21$) with a skewed prior versus the best Gaussian approximation of that prior. Kolmogorov-Smirnov tests suggested that the shape of the communicated prior led to significantly different error distributions ($D = .065$, $p < .001$) even though the stimulus distributions were equivalent. These results show that people are sensitive to more than expected mean, mode, and variance of stimuli in the environment; people can encode and utilize information about third-order statistics such as skew. This work is further evidence that perception is richly sensitive to stimulus probabilities.

Acknowledgements: NYUAD Research Enhancement Fund REF-175

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

For any queries, please contact Syaheed Jabar at sbj2@nyu.edu or syaheed@gmail.com.

Abstract ID: 286

Modeling human multitasking behavior in video games through modular reinforcement learning

Talk Presentation - *Topic area: Perception and Action: Decision making*

Sihang Guo[1] (sguo19@utexas.edu), Bharath Masetty[1], Ruohan Zhang[1], Dana Ballard[1], Mary Hayhoe[1];
[1]University of Texas Austin

For reward-seeking multitasking behaviors, humans make decisions to maximize the collective reward for several ongoing behavioral goals. Another view is that complex behaviors can be broken down into multiple modules, each of which requires specific visual information. It was shown that deep neural networks can accurately model human decisions in multitasking gaming environments (Zhang et al., 2018). However, these models provide little explanation of why a particular decision is made. Meanwhile, non-deep models such as modular reinforcement learning (MRL; Rothkopf and Ballard 2013) provide explicit and interpretable measurements of task rewards and discount rates for each behavioral goal. For example, in a game called Freeway where players control a chicken to cross a busy highway, MRL assumes that each module (e.g., vehicles) is associated with a unique reward and discount rate. We develop a computer vision algorithm to extract relevant visual information for human decision making, such as object positions and velocities. We feed extracted information and human decision data (Zhang et al., 2019) into the MRL algorithm to estimate module rewards and discount rates. Our results show that the MRL model is able to make human-like decisions, achieving a game score of 32 (human average: 33) and is significantly better than previous non-deep heuristic-based and RL methods (0-22.5). Furthermore, the modeling results are interpretable. The estimated rewards indicate a module's relative importance compared to the others. The discount rates determine how much a reward decays over temporal/spatial distances for a module. We also found that using separate discount rates for different spatial dimensions is necessary: e.g., a vehicle has a high discount rate only along its heading direction, hence its reward only affects the space in front of or behind the vehicle. We conclude that MRL could be a useful model for multitasking visuomotor behaviors.

Acknowledgements: NIH EY05729

This talk will be presented in Live Talk Session 7, Tuesday, 23 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1552

Neurocomputational Mechanisms of Action-Outcome Prediction in V1

Talk Presentation - *Topic area: Perception and Action: Decision making*

Clare Press[1] (c.press@bbk.ac.uk), Emily Thomas[1], Sam Gilbert[2], Floris de Lange[3], Peter Kok[4], Daniel Yon[1,5]; [1]Birkbeck, University of London, [2]Institute of Cognitive Neuroscience, University College London, [3]Donders Institute for Brain, Cognition and Behaviour, Radboud University, [4]Wellcome Centre for Human Neuroimaging, University College London, [5]Goldsmiths, University of London

Goal-directed action depends on our ability to anticipate the outcomes of our movements. Recent accounts have suggested that the predictive mechanisms deployed during action operate according to general principles of perceptual prediction – with observers using top-down knowledge about likely action consequences to bias perception of expected outcomes and to 'sharpen' representations in the sensory brain. However, it remains unclear what kind of mechanism generates these effects, and there is continuing controversy surrounding the relationship between predictive effects on the sensory brain and behavior. Here we present a new experiment addressing this controversy by combining multivariate fMRI with computational modelling of participant choices in an action and perception task. In a behavioral acquisition phase, participants acquired perfect associations between manual actions and gratings with particular orientations. In a subsequent MRI test session, participants produced manual actions either with no visual effect (33%), or to generate gratings with an orientation that was expected (33%) or unexpected (33%) on the basis of the preceding training. When expectations were valid, decisions about the grating orientation were faster than on unexpected trials and modelling indicated that this effect was explained by biases in sensory evidence. Representations of outcomes in primary visual cortex (V1) were also 'sharpened' relative to unexpected trials, such that linear support vector machines classified the identity of the gratings from patterns of V1 activity with superior accuracy. Moreover, we performed a number of analyses allowing us to examine the relationship between the V1 processing and behavioral decisions, revealing how effects of action prediction in primary visual cortex are related to what agents see and what they decide.

Acknowledgements: Leverhulme Trust; Wellcome Trust

This talk will be presented in Live Talk Session 7, Tuesday, 23 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 712

Octopus bimaculoides can learn to use a mirror to find food not in the line of sight

Talk Presentation - *Topic area: Perception and Action: Decision making*

Marie-Luise Kieseler[1] (mlk.gr@dartmouth.edu), Marvin Maechler[1], Zachary Hoffman[1], Navneet Dhanoa[1], Jean Fang[1], Scott Giess[1], James McHugh III[1], Mira Ram[1], David Edelman[1], Marcus Missal[1,2], Peter Tse[1]; [1]Dartmouth College, [2]UC Louvain

When driving, we use mirrors to localize objects that would otherwise be invisible to us because they lie outside our field of view. Various species of vertebrates can learn to use a mirror to localize objects hidden from their view (monkeys: Anderson and Gallup 2011; chimpanzees, Menzel et al. 1985; a gorilla, Nicholson and Gould 1995; elephants, Povinelli 1989; pigs, Howell and Bennett 2011; African gray parrots, Pepperberg et al. 1995; crows, Medina et al. 2011). Octopuses are highly capable visual hunters who prey on live crabs. In the present study, we tested the hypothesis that Octopus bimaculoides could learn to use the mirror image of a visual scene to localize a predictor of food reward. Three octopuses were tested in the present study. At the beginning of each trial, the animal was placed in an opaque box facing a mirror. A virtual crab was projected on a back screen hidden from view of the subject, but its image was reflected in the mirror. The animal's task was to move out of the box, turn around and go to the side where the virtual crab was projected. This required using the mirror as a tool to locate the side of the projected but 'hidden' crab (Supplementary Figure 1, Panel A). We found that octopuses made the correct choice significantly more often than the incorrect choice (O1: 9/10, O2: 6/8, O3:6/9; Fisher: chisq=15.68, df=6; $p<.05$). A simulation of this experiment with 250,000 iterations revealed that the frequency of correct choices was not due to chance ($p= 0.002524$, Supplementary Figure 1, Panel B). In conclusion, we showed that octopuses are capable of learning to utilize a mirror to infer where their prey was located. This requires the cognitive capacity to use a complex visual representation of the environment to drive goal-oriented behavior.

Acknowledgements: National Science Foundation Award #1632738

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 551

The influence of reward and top-down task set on goal-directed movements

Talk Presentation - *Topic area: Perception and Action: Decision making*

Tom Nissens[1] (tom.nissens@gmail.com), Katja Fiehler[1]; [1]Justus-Liebig University Giessen

When presented with a set of possible reach targets, movement trajectories can reveal aspects of the underlying competition for action selection. (i) Stimuli associated with reward have been shown to attract reaching movements when the reward stimuli were physically salient and reaching to them was previously rewarded. In the first study, participants had to reach towards a target diamond shape surrounded by differently colored distractor circles. On some trials the color of one of the distractors signaled the availability of earning either low or high reward. The results showed that stimuli that signal high reward attract reaching movements. This effect was particularly pronounced for short latency movements. We concluded that stimuli signaling the availability of earning reward gain priority during the selection for action even when the reward stimulus is non-physically salient and reaching towards them was never rewarded nor necessary. (ii) Furthermore, physically salient distractors typically attract reaching movements. Previous studies on covert and overt attention showed that, under certain top-down task sets, a physically salient distractor can be quickly suppressed to avoid capture. However, it is unclear whether active suppression also occurs during reaching movement planning. In the second study, participants were asked to reach towards a target diamond shape surrounded by distractor circles. All shapes could be in the same color or one of the distractor shapes could be in a physically salient color. In one session participants had to search the reach target; in another session the reach target was cued. The results showed that the highly physically salient distractor attracted reaching movements performed to the searched target but not to the cued target. We conclude that the priority towards physically salient stimuli during selection for action can be actively suppressed under certain top-down task sets, avoiding attraction.

Acknowledgements: This project was supported by the German Research Foundation, International Research Training Group, IRTG 1901, “The Brain in Action”.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 214

Visual cue estimation with non-gaussian distribution

Poster Presentation - *Topic area: Perception and Action: Decision making*

Keiji Ota[1] (ko917@nyu.edu), Qihan Wu[2], Pascal Mamassian[3], Laurence Maloney[1]; [1]New York University, [2]Johns Hopkins University, [3]École Normale Supérieure

Introduction. Many models of ideal perception and action presuppose that error probability density functions are Gaussian. In cue combination (Landy et al., 1995), ideal combination results in a combined estimate that is unbiased and that minimizes variance (UMVUE) but only if the underlying distributions are Gaussian (Oruc et al., 2003). What if the distributions were not Gaussian? Are we just Gaussian machines or do we have a wider range of adaptability to scene statistics? Would the visual system continue to employ the sub-optimal Gaussian rule? Or would it adapt to the UMVUE of a new distribution? To investigate this hypothesis, we asked observers to estimate the population mean of samples drawn from a Gaussian, Laplacian, or Uniform distribution. The UMVUE for the Gaussian is the mean of the sample, for the Laplacian, it is the median, and for the Uniform it is the average of the largest and smallest value. Methods. Twenty observers saw 9 dots and had to locate the mean of the underlying distribution. They received initial training with the three distributions/samples interleaved. The samples were color-coded so that the observer always knew which distribution a sample came from. Analysis. We performed a regression analysis to estimate the observer's weights on sample information and compared it with normative UMVUE weights. Observers markedly changed their weights for three different samples. For a uniform sample, they correctly used the average of the two bounds of the sample. For a Laplacian sample, the observers relied mostly on the points around the median. Interestingly, the rule used for the Gaussian was not UMVUE but distinct from that used for either of the other distributions. Learning the new rules took less than 100 trials. Conclusion. Human estimates were not perfect, but humans use of sample information varied with the underlying distribution.

Acknowledgements: This research was supported by Grant-Aid for JSPS Fellows No. 17J07822 awarded to KO and by Guggenheim Fellowship awarded to LTM.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1436

Perception and Action: Hand and body movement

A right-lateralized effect of motor experience on manipulable object representations

Poster Presentation - *Topic area: Perception and Action: Hand and body movement*

James Caracoglia[1,2] (jac546@georgetown.edu), Ella Striem-Amit[1,3], Gilles Vannuscorps[3,5], Alfonso Caramazza[3,4]; [1]Department of Neuroscience, Georgetown University Medical Center, [2]Division of Graduate Medical Sciences, Boston University Medical Center, [3]Department of Psychology, Harvard University, [4]Center for Mind/Brain Sciences, University of Trento, [5]5Faculty of Psychology and Educational Sciences, Psychological Sciences Research Institute and Institute of Neurosciences

Object representations include knowledge of their shape, function, manipulability and use kinematics, organized in various dedicated neural networks. Here, we tested the role of motor-manipulation knowledge and experience on object perception in people born without hands (i.e., upper limb dysplasics) who, because of this deficit, cannot use certain tools for which they have intact knowledge otherwise. Recently, we have shown that these right-footed individuals have similar hand-tool association and intact action observation networks as compared to typically developed controls. Therefore, we anticipated representation of motor manipulation knowledge and experience to be evident in the left-lateralized praxis and tool-use network. Surprisingly, we found a result that is not interpretable in this classical framework. Specifically, presentation of manipulable objects with which the upper limb dysplasics had motor experience preferentially activated a widespread, right-lateralized network that included right ventral visual cortex, posterior middle temporal lobe, and middle frontal gyrus, not the left-lateralized, tool-selective network. However, object decoding based on the dysplasics' motor knowledge highlighted classical tool and action/praxis regions bilaterally. While we are puzzled by these results, they possible suggest that praxis network lateralization is unique to hand use, such that foot use praxis does not benefit from apriori left specialization and reorganizes to the right hemisphere in the absence of hands.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1347

Effector-independence in the visuo-motor system: the case of foot action in people born without hands

Poster Presentation - *Topic area: Perception and Action: Hand and body movement*

Ella Striem-Amit[1,2], Yuqi Liu[1], Gilles Vannuscorps[2,3,4], Alfonso Caramazza[2,3]; [1]Department of Neuroscience, Georgetown University Medical Center, Washington, DC 20057, USA, [2]Department of Psychology, Harvard University, Cambridge, MA 02138 USA, [3]Center for Mind/Brain Sciences, University of Trento, 38068 Rovereto, Italy, [4]Faculty of Psychology and Educational Sciences, Psychological Sciences Research Institute and Institute of Neurosciences, Université catholique de Louvain, Louvain-la-Neuve, 1348, Belgium

Many parts of the visuo-motor system are engaged in guiding the movement of the hands for daily tasks like reaching for and grasping objects. But to what extent is the organization of these regions dependent on the hand as a specific body part whose movement they guide, and to what extent are they organized for the grasping task, regardless of the body part used as an effector? We tested a unique population, people born without hands who use the feet as the primary effector (dysplasics), to address this question. In a functional neuroimaging experiment, dysplasics and typically-developed controls performed grasping and reaching actions with their primary effector, that is, the right foot for the dysplasics and right hand for the controls. Beyond primary sensorimotor cortices which showed selectivity for the hand and foot, we found a preference based on action type in parietal and frontal motor association areas including left anterior intraparietal sulcus and dorsal premotor cortex, regardless of the effector used. These results indicate that some motor association areas are organized based on abstract action functions independent of the specific sensorimotor parameters.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Check out poster #1351 for behavioral similarities between hand and foot actions.

Abstract ID: 1236

Foveation-like behavior in human haptic search

Poster Presentation - *Topic area: Perception and Action: Hand and body movement*

Anna Metzger[1] (anna.metzger@psychol.uni-giessen.de), Matteo Toscani[1], Matteo Valsecchi[2], Knut Drewing[1]; [1]Justus-Liebig University Giessen, [2]University of Bologna

In vision, only the information projected onto the central portion of our retina is perceived with high resolution. Therefore, the visual system needs to process the full visual scene with coarse resolution through peripheral vision and shift the eye in order to analyse a selected portion in detail (foveation). This process allows to reduce the complexity of visual processing by serializing detailed analysis. A haptic process analogous to foveation has been described in the behavior of the blind star-nosed mole, who detects potential prays with any of its tactile appendages but analyzes it with a specific pair, characterized by higher tactile resolution. Here we tested the hypothesis of haptic foveation behavior in humans. Nine participants searched for a particular configuration of symbols on a planar rigid tactile display. We computed the probability for each finger of touching a potential target after it was previously encountered by any of the other fingers, and the exploration speed of each finger while exploring a potential target. Independent of which finger encountered a potential target first, there was higher probability that subsequent exploration was performed by the index or the middle finger. At the same time, these fingers dramatically slowed down, suggesting that these specialized fingers are involved in detailed analysis. In a second experiment we tested the hypothesis that foveation is performed to gain information. Ten participants searched either for an easy target (a rough patch among smooth ones) or a difficult one (a hole in a certain corner of a patch). Overall, we replicated the results of the first experiment. Corraborating our hypothesis, specialized detailed analysis was reduced in easy search, suggesting that foveation behavior was employed less if it provided less information gain. Our results suggest that in haptic search humans employ foveation-like behavior similar as in vision.

Acknowledgements: This work was supported by Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 222641018 – SFB/TRR 135, A5

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1105

Influence of Gaze Direction and Saccades on Hand Location and Orientation Errors in a Memory-Guided Alignment Task

Poster Presentation - *Topic area: Perception and Action: Hand and body movement*

Gaelle N. Luabeya[1,2,3] (nsambalu@my.yorku.ca), Xiaogang Yan[1,2], J. Douglas Crawford[1-5]; [1]Centre for Vision Research, York University, Toronto, ON, Canada, [2]Vision Science to Applications (VISTA), York University, Toronto, ON, Canada, [3]Department of Biology, York University, Toronto, ON, Canada, [4]Department

Kinesiology, York University, Toronto, ON, Canada, [5]Department Psychology, York University, Toronto, ON, Canada

The influence of gaze position/saccades on pointing and reach location have been studied extensively (e.g., Henriques et al., J. Neurosci. 1998), but their influence on grasp orientation has received less attention (Selen & Medendorp, Vision Res. 2011). Here we investigated the influence of gaze direction and saccades on hand location and hand orientation in a memory-guided alignment task. Participants (N=15) were instructed to reach and orient a hand-held rectangular 3D object against a 2D rectangular target with similar dimensions, presented briefly at two possible orientations (+45o or -45o from horizontal) at the center of an LED screen. Participants either maintained gaze fixation throughout the trial (toward a fixation point placed centrally or 10o left/right), or the fixation point shifted after the rectangular target disappeared, inducing a saccade just before the reach. Saccade trials were either centripetal (from 10o left/right toward center), centrifugal (center-out), or across fields, i.e., reversing the visual field location of the central reach target. Preliminary analysis confirmed a tendency to overshoot hand location in the direction opposite to final gaze location, during both fixation and saccade conditions, inducing a positive correlation between location errors in both tasks (Henriques et al. 1998). Hand orientation also tended to overshoot the orientation of the target rectangle. However, participants showed idiosyncratic gaze-dependent orientation errors: some showed little or no effect, whereas others showed inconsistent patterns. Further, final gaze-dependencies did not consistently correlate between fixation and saccade trials. In conclusion, this study extends the phenomena of ‘gaze-dependent overshoot’ and ‘gaze-centered updating’ (Henriques et al. J. Neurosci. 1998) to hand alignment. However, we found inconsistent evidence for gaze modulation of alignment, perhaps because the independent variable (horizontal gaze) was spatially independent from the dependent variable (clockwise / counterclockwise orientation). Further tests are needed to determine if this holds for other tasks.

Acknowledgements: Canadian Institutes of Health Research, the Vision: Science to Applications Program (funded in part by the Canada First Research Excellence Fund), and the Canada Research Chairs Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

If you would like more information, I will be more than happy to hear from you. You can connect with me via email: gaellenl@yorku.ca.

Abstract ID: 866

Reciprocal facilitation between mental rotation and visuomotor rotation

Poster Presentation - *Topic area: Perception and Action: Hand and body movement*

Jianfei Guo[1] (jianfei_guo@brown.edu), Joo-Hyun Song[1]; [1]Brown University

Although our mental functions can only be expressed in the world through our actions, historically, there is little work linking cognitive and motor processes. Previous studies have demonstrated that visual mental rotation and visuomotor rotation have similar processing rates and brain regions involved in (Pellizzer & Georgopoulos, 1993; Georgopoulos et al., 1989). However, as correlational studies, these cannot fully determine whether a common mechanism drives motor and mental rotation. To address this question more directly, we investigated whether training in visuomotor rotation can improve performance in visual mental rotation and vice versa. In the visuomotor rotation task, participants were required to reach to a target, while the cursor feedback was rotated 45º to force movement adaptation. In the visual mental rotation task, participants were asked to decide whether a letter (e.g., R) in different rotation angles was normal or mirror-reversed. We found that after the visuomotor rotation training session, participants became faster in visual mental rotation compared to before. In turn, we also observed that the learning rate of visuomotor adaptation was improved after a mental rotation training session. We also conducted control experiments in which participants were trained on a motor task without requiring rotational adaptation (i.e., a direct reach and a sequential reaction time task) and a letter color discrimination task without requiring the rotation judgment. Training on these tasks resulted in a significantly weaker transfer to their counterparts. Thus, we ruled out that some simple motor and perceptual transfer led the observed reciprocal improvement. What is remarkable about this reciprocal plasticity is that these two tasks are very different in terms of perceptual input and motor response. Nevertheless, transfer occurred. Could this mean that the operation of “rotation” itself is a primitive for perception and action that has yet to be fully identified or understood?

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 405

Reduced Functional Dissociation Between Action and Perception in Individuals with Autism

Poster Presentation - *Topic area: Perception and Action: Hand and body movement*

Zoha Ahmad[1] (zohahmad@my.yorku.ca), Nahal Binur[2], Tzvi Ganel[3], Bat-Sheva Hadad[2], Erez Freud[1]; [1]Centre for Vision Research, York University, [2]Department of Special Education and Edmond J. Safra Brain Research Center, University of Haifa, [3]Department of Psychology and Zlotowski Center for Neuroscience, Ben-Gurion University of the Negev

Perceptual changes are a widely acknowledged but poorly understood feature of autism. One hypothesis is that those changes are the result of reduced cortical specialization. Here, we sought to examine this hypothesis by exploiting the well-established functional dissociation between the ventral pathway that mediates vision-for-perception, and the dorsal pathway that mediates vision-for-action. We predicted that a reduced cortical specialization would lead to atypical intrusions of perceptual effects in action. To this end, we examined the effect of the Ponzo Illusion on perception and action in a group of typically developed adults and individuals with autism. Two objects that differ in their real size were placed on the illusory background such that there was a conflict between the real size and the perceived size of the objects. In each trial, participants made perceptual size discriminations and then grasped one of the objects based on its perceived size. Consistent with previous results, the maximum grip apertures (MGA) of the typically developed participants were scaled to the real size of the object, even in trials in which their overt perceptual decisions were deceived by the illusion. This, however, was not the case for individuals with autism. In particular, for this group, the MGA were not scaled to the real size of the objects when perceptual decisions were incorrect. These results provide novel evidence for a reduced functional dissociation between perception and action in individuals with autism.

Acknowledgements: This research was funded by Natural Sciences and Engineering Research Council of Canada (NSERC) (EF) and by the Vision Science to Applications (VISTA) program funded by the Canada First Research Excellence Fund (CFREF, 2016–2023) (EF)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1238

Semantic embeddings of verbal descriptions predict action similarity judgments

Poster Presentation - *Topic area: Perception and Action: Hand and body movement*

Leyla Tarhan[1] (ltarhan@g.harvard.edu), Julian de Freitas[1], George Alvarez[1], Talia Konkle[1]; [1]Harvard University

Every day, we see people perform many different actions, some of which naturally seem more similar (e.g. running and walking) while others are more different (e.g. running and cooking). What properties of actions capture this intuitive perception of similarity? To address this question, we asked sixteen participants to watch 60 videos depicting everyday actions, then place intuitively similar actions closer together in space (Kriegeskorte & Mur, 2012). We then tested how well a range of features predicted these action similarities, spanning low-level shape features (gist; Oliva & Torralba, 2001), intermediate-level features capturing the body parts involved in the actions and the actions' targets in the world (Tarhan & Konkle, 2019), and high-level semantics. To operationalize high-level semantics, we used verbal descriptions to extract each video's embedding in a neural network feature space. First, 3 observers verbally described each video. Then, transcripts of their descriptions were passed through a deep neural network model trained on natural language processing (BERT; Devlin et al., 2019), producing a 1024-dimensional feature code for each description. Gist features did not predict action similarity judgments well (mean leave-1-out tau-a = 0.07), while body part and action target features performed better (tau-a = 0.2 and 0.12, respectively). Notably, semantic BERT features performed best (tau-a = 0.25), approaching the noise ceiling. We replicated these results in a second group of participants (N = 20). These findings suggest that humans perceive action similarity primarily in terms of semantic properties that can be extracted from natural language. This may be because verbal descriptions capture actions' larger event structures, going beyond the bodies and objects that make up their elemental components. In addition, our use of verbal descriptions and natural language processing models introduces a tractable way to measure semantic features for real-world, complex videos.

Acknowledgements: Funding for this project was provided by NSF grant DGE1144152 to L.T., the Harvard University Norman Anderson Fund Grant to L.T., and the Star Family Challenge Grant to T.K.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1241

Perception and Action: Navigation, locomotion

A homing task that could not be done by image matching.

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Maria Elena Stefanou[1] (m.e.stefanou@reading.ac.uk), Alexander Muryy[1], Andrew Glennerster[1]; [1]University of Reading

Returning to a previously visited location ('home') could be done by image matching or by 3D reconstruction of the scene. We have shown that participants' errors are better predicted by image-matching but here we restrict participants' views to prevent them using this strategy. In the learning phase, participants in immersive virtual reality viewed a naturalistic indoor scene from one zone (binocular vision and limited head movements) with a restricted field of view (90 degree cone) and only one viewing direction permitted (e.g. North). After participants became familiar with the view, the cyclopean point was briefly frozen with respect to the scene (definition of 'home'). Participants were then teleported to another location and had to return to 'home' (search phase). Again, the FOV was restricted, but the direction could be 0, 90 or 180 degrees different from the learning phase. The learning-phase view was always towards the centre of the room and participants had a sufficient view of objects in both the learning and search phases to ensure that the task was always possible. Participants' errors (RMSE of reported location relative to 'home') increased as a function of the angle between the learning and search phase viewing directions. When the search phase orientation differed by 90 or 180 degrees, the reported location was systematically shifted in the direction of the view in the search phase (GROUP: $p < .0001$). The fact that participants are able to return relatively close to 'home' rules out (by design) the hypothesis that they are using an image-matching strategy to solve the task. On the other hand, a 3D reconstruction hypothesis does not predict these systematic biases. Any image-based strategy that could explain these data would need to rely on something like the latent space interpolation that has been so successful in generative adversarial networks (GANs).

Acknowledgements: Funded by EPSRC/Dstl EP/N019423/1

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 396

A naturalistic navigation task reveals rich distributed representations of information across the human cerebral cortex

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Tianjiao Zhang[1], Jack L Gallant[1]; [1]University of California, Berkeley

Navigation in the natural world is a challenging problem that engages many cognitive systems, including cognitive maps, attention, motor control, and planning. However, most fMRI navigation studies use highly simplified environments and tasks that are unlikely to engage all navigational processes. Thus, they cannot create detailed functional cortical maps of the many different types of information that are likely relevant for natural navigation. To recover detailed cortical maps of navigation-related information, we used fMRI to record whole-brain activity while subjects performed a taxi driver task in virtual reality. The pilot environment is a 1×1 km town without other agents. The main environment is a 1×2 mile city with traffic, pedestrians, and various neighborhoods and off-road areas. Subjects drove using an MR-compatible steering wheel and pedals constructed in our lab. One subject participated in the pilot for 130 minutes and the main environment for 260 minutes. A second subject participated in the pilot for 90 minutes. We applied the voxelwise modeling framework to the data. We extracted stimulus and task features from the experiment, and used banded ridge regression to find optimal weights for each feature for every voxel in each subject. We evaluated 16 feature spaces that captures various aspects of navigation. We used a separate dataset to test statistical significance and generalization of models in each subject. The recovered cortical maps show the PPA, RSC, and OPA represent information about roads, buildings, and boundaries. RSC and precuneus tracks route progression. Visual motion-energy is represented across visual cortex, including the posterior parts of RSC, OPA, and PPA. FFA and EBA represent information about pedestrians and other vehicles. These results show that naturalistic navigation elicits rich cortical activity and navigation information is represented in distributed networks of brain regions.

Acknowledgements: Ford URP Grant, ONR MURI N000141410671, and NSF GRFP under DGE 1752814 & DGE 1106400

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 462

Children’s walking in complex environments: one step at a time?

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Rachel Mowbray[1], Anthony Atkinson[1], Dorothy Cowie[1]; [1]Durham University

INTRODUCTION: The natural walking environment is cluttered and changeable. For safety and efficiency, the feet must be placed precisely, into tightly constrained locations. This requires both sensitivity and responsivity to visual cues about the environment. By 8 years, children use visual information to guide single, precise steps in an adult-like way (Mowbray et al, 2019). But do children of this age benefit from distal visual cues about the upcoming terrain during walking? Do children plan ahead like adults (Matthis et al, 2018)? Or do they control walking one step at a time, using proximal visual cues? METHODS: Adults (N=30) and 8 year olds (N=30) walked across a series of stepping targets in virtual reality. We manipulated the number of visible upcoming targets to 1, 2 or 3 steps ahead. Participants also completed a virtual single-step task. We used motion capture to record speed and step error. RESULTS: Both children and adults walked more slowly when vision was restricted to just one step ahead $F(2, 116)=6.172$, $p=.005$. Children’s error was higher than adults for single steps $F(1, 58)=23.049$, $p<.001$, and was consistently higher than adults’ during walking - regardless of visual condition $F(1, 58)=135.202$, $p<.001$. Adults showed higher error when given more visual information about the upcoming terrain $F(2, 58)=5.1$, $p=.009$. CONCLUSIONS: Given more visible upcoming targets, both adults and children walk more quickly. Adults show an accompanying increase in foot placement error. For children, foot placement error is consistently high across conditions. We conclude that 8 year olds do use distal cues to select appropriate walking speed. However, children are unable to use distal visual cues to adjust step accuracy. In summary, at self-selected speed, both children and adults walk more slowly when they are unable to plan ahead. For adults only, this allows better control of foot placement error.

Acknowledgements: This work was funded by ESRC grant ES/J500082/1

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for taking the time to view my poster.

Please note that my poster includes a second, more recent study (as well as the original study described in my abstract). In study 1, we ask whether children (8 years) visually sample the upcoming terrain to plan their walking like adults. In study 2, we additionally manipulate the level of postural threat.

Although the abstract mentions a single step task, the poster focuses exclusively on the visually guided walking task.

Please watch my video presentation for a more detailed explanation. The video also includes videos of the virtual reality task from the participant's perspective.

Abstract ID: 274

Closer than it appeared: Distorted spatial memory during virtual navigation

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Kathryn N. Graves[1] (kathryn.graves@yale.edu), Brynn E. Sherman[1], Nicholas B. Turk-Browne[1]; [1]Yale University

As we navigate the world, we tend to visit multiple locations within a local neighborhood (e.g., spots in a parking lot, restaurants on a block, offices in a building). We remember not only these individual locations but also abstract over these locations to represent their underlying spatial distribution. We have previously shown that such patterns guide future navigation when searching for new locations in a familiar environment. However, what is the fate of the individual past locations? Are these representations distorted by the distribution of other locations, for example, pulled toward the mean of the distribution? Or are patterns generated in parallel with high-fidelity memory for individual locations? We could not test this previously because participants in our earlier studies were never instructed to return to an old location. In a new study, participants virtually navigated a circular arena with an outer-space theme. During training, they were exposed to a distribution of five locations across search trials, each appearing as a colored disk. On each trial, participants were prompted with a color word that informed them of the disk they should find. They were then shown the disk in the arena and navigated to it repeatedly. During test, participants were again given a color prompt but no disk was presented in the arena. Instead, they had to rely on spatial memory for the past location of the corresponding disk. Their navigational behavior thus provided a rich source of information about how this location was represented. Participants generally navigated toward the correct location but were biased to stop in a location that was closer to the other experienced locations. These findings suggest that statistical learning helpfully extracts patterns that can guide navigation to new locations probabilistically, but that this comes at the expense of distorted memory for old locations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1056

Differential encoding of dynamic objects in navigational context

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Hee Kyung Yoon[1] (hee.k.yoon@yonsei.ac.kr), Hee Yeon Im[2], Soojin Park[1]; [1]Yonsei University, [2]Boston Children's Hospital and Harvard Medical School

A fundamental challenge in the visual system is that objects and boundaries within a scene are all but stationary. For example, dynamic displacements of potential obstacles across time could either render a previous path unnavigable or provide a new path through which we can travel. How are the subsequent movements of a dynamic object accounted for as we encode navigability in a given space? In this study, we hypothesized that the encoding of object displacement in a navigationally relevant setting would be different from that in a navigationally irrelevant setting. We artificially rendered a 3D environment with a sliding door as a dynamic object, opening gradually as a camera moved forward towards the door. In experiment 1, participants saw a short video of the door opening to a certain width. In experiment 2, the 3D-cue of the rendered environment was minimized by replacing the video with a line drawing of a door opening as a camera moved forward. Experiment 3 further reduced the 3D-cue by simply translating a line drawing of a door horizontally, without a forward movement. After the video, participants were shown a probe image and answered if the door on the probe was narrower or wider than the video that preceded it. The point of subjective equality (PSE) was calculated to measure how participants encoded the dynamic object. We found a gradual decrease of the PSE as more 3D-cues were present in the visual environment. Specifically, participants overestimated the width of the door in simple line drawings (Experiment 2 and 3), suggesting that a representational momentum is in effect. Interestingly, participants underestimated the width of the door in a full 3D scene (Experiment 1), showing an opposite of representational momentum. These preliminary findings suggest differential encodings of dynamic objects in navigationally relevant environment.

Acknowledgements: This work was supported by National Eye Institute (NEI) grant (R01EY026042), National Research Foundation of Korea (NRF) grant (funded by MSIP-2019028919) and Yonsei University Future-leading Research Initiative (2018-22-0184) to SP.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1744

Effect of manipulating appearance of stairs on perceived step height

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Shree Venkateshan[1] (venkatss@mcmaster.ca), Allison Sekuler[1,2,3,4], Patrick Bennett[1]; [1]McMaster University, [2]Rotman Research Institute, [3]Baycrest Health Sciences, [4]University of Toronto

Falls on stairs affect people of all ages, and are a leading cause of injury and accidental death among older adults. One strategy that can reduce falls walking up stairs is to lift the foot slightly higher than the minimum height that is required to clear the step's leading edge. Visual cues can encourage people to adopt this strategy by constructing steps that are perceived as being slightly higher than their veridical height. Elliot et al. (2009) found that placing high contrast, vertical gratings on a step increased the perceived height of that step compared to steps without the gratings. The present study attempted to replicate these findings. We measured the perceived height of steps that contained high contrast, vertical square wave textures with spatial frequencies of 4, 12, and 20 cy/step. Stimuli were line drawings of stairs containing three steps. On each trial, subjects were shown two sets of stairs: one that contained the high-contrast texture on the bottom step (test step), and another that did not contain the texture (reference step), and judged which stairs contained the taller bottom step. The height of the reference step varied across trials using the method of constant stimuli, and we derived the point of subjective equality from psychometric functions. Results from 22 young adults showed that the presence of the texture increased the perceived height of the step by 5%, and that the size of the effect was nearly constant across spatial frequencies. This result suggests the perceived height of a step can indeed be affected by a simple visual illusion, which might lead to a safer stepping strategy. Currently we are examining how age and the effects of other parameters of the textures impacts perceived step height.

Acknowledgements: National Science and Engineering Research Council, Canada Research Chair Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

June 19, 6:00pm -
https://us02web.zoom.us/j/81272477536?pwd=d3hTdjZFOG5kc2Z4NG9Ca0JLRmdSUT09
Meeting ID: 812 7247 7536
Password: Stairs123

June 20, 1:00 am -
Join Zoom Meeting
https://us02web.zoom.us/j/83647493798?pwd=cmQyUkVkSWt3ZW5XMTcveU5hcWpYZz09
Meeting ID: 836 4749 3798
Password: Stairs123

June 21, 11:00 pm -
Join Zoom Meeting
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Abstract ID: 1438

Spatial and Non-Spatial Factors in Wayfinding

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Serena DeStefani[1] (sd911@rutgers.edu), Davide Schaumann[2], Xun Zhang[1], Jacob Feldman[1], Mubbasir Kapadia[1]; [1]Rutgers University, [2]Cornell Tech

We studied spatial navigation (wayfinding), focusing on the decisional processes by which subjects decide what path to take through a complex environment. In addition to spatial factors as usually emphasized in the literature, we focused on “subjective” components, meaning social or functional valences that people attach to parts of the environment. To understand how people are affected by space semantics, we built a virtual hallway that our subjects could navigate and explore through a desktop computer. The hallway featured a desk that had a different appearance depending on the assigned condition: participants may see a bare desk, or a desk covered by objects in use, or a desk currently being used by an agent standing behind it. We also modified the amount of space between the desk and the adjacent wall, and the participant’s starting point (closer to the wall or far away from it). We then tested how these non-spatial and spatial cues affected people’s navigational choices - specifically how willing they were to go behind the desk (i.e.

on the side where the desk user might be). We fitted a multinomial logistic Bayesian regression evaluating the factors predicting the participants' choices. We found that purely spatial factors such as the participant's starting point ($F(2)=55.25$, $p<0.0001$) and the table position ($F(2)=21.78$, $p<0.0001$) were weighed more heavily than the semantic qualities of the environment, including the table's appearance ($F(2)=9.89$, $p=0.0001$). However space semantics did play a role: subjects tended to avoid area semantically marked as "in use" by another person, but only up point in the point at which geometric conditions made it extremely inconvenient to avoid. We conclude that space semantics play a role in wayfinding, albeit one secondary to ordinary spatial factors.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for your interest in our work!

If you have any questions or comments, feel free to either post them in the chat, or to join me during a Zoom conference or to email me at:
sd911@scarletmail,rutgers.edu

I am looking forward to hearing from you.

- Serena

Abstract ID: 1664

The influence of gaming frequency and viewing perspective on a remote robot operation task

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Benjamin P Hughes[1] (bephughe@ucsc.edu), Kevin Weatherwax[1], Madison Moxley-Fuentes[1], Gurdikhia Kaur[1], Nicolas Davidenko[1], Leila Takayama[1]; [1]University of California, Santa Cruz

Frequent video game players ("gamers") perform better on certain visuospatial tasks compared to non-gamers (Green & Bavelier, 2003). Furthermore, visuospatial ability has been associated with performance on teleoperation tasks, in which participants remotely operate robots or devices (Gomer & Pagano, 2006; Menchaca-Brandan, Liu, Oman, & Natapoff, 2007). The present study sought to further explore these

associations by testing gamers' and non-gamers' performance in a teleoperation task where they drove a Beam robot through an obstacle course using two different input devices (Xbox controller and keyboard) under two different viewing perspectives (egocentric or allocentric). Participants ($N = 60$; 35 female, 25 male) were instructed to drive the robot through the course as fast as possible while hitting as few cones as possible. Each participant completed two laps in each of the four combinations of conditions (2 controllers X 2 perspectives), in a randomized order. Performance was operationalized by course completion time and number of cones hit. Two-way ANCOVAs found that gamers (reporting an average of 8hrs of weekly gameplay in a post-task survey) showed faster course completion times ($F(1,57) = 5.65$, $p < .05$, partial $\eta 2 = .09$), but no difference in errors, compared to non-gamers (average of 1hr of weekly gameplay). Additionally, two-way ANCOVAs indicated an interaction between input device and viewing perspective ($p < .05$), such that when using the Xbox controller, participants were faster to complete the course under an egocentric perspective compared to an allocentric perspective. Moreover, male participants performed faster and made fewer errors than female participants, and only female participants showed an overall advantage of the egocentric perspective, consistent with previous research (Nowak, Murali, & Driscoll, 2015). These results add to a growing body of literature demonstrating an association between gaming and teleoperation skills, although the underpinnings of this association require further research.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

If you're interested in this work or want to know more, please email me at bephughe@ucsc.edu .

Abstract ID: 1706

Updating strategy is independent of memory representation used in spatial updating

Poster Presentation - *Topic area: Perception and Action: Navigation, locomotion*

Lu Ruoyu[1], Mou Weimin[2], Li Zhi[1]; [1]Zhejiang University, [2]University of Alberta

Spatial updating of self-to-object spatial relations could be performed either online or offline. According to the two-system theory of spatial updating, online updating is associated with transient representations and the presence of set size effects, whereas offline updating is associated with enduring representations and the absence of set size effects. However, this fixed updating-memory hypothesis is challenged in the present study. Meanwhile, a flexible updating-memory hypothesis is proposed, including two assumptions. First, updating strategy (online or offline) is independent of spatial representation (transient or enduring).

Second, it is the type of spatial representation rather than updating strategy that determines whether set size effects may occur. Two experiments were conducted to verify these new assumptions. Experiment 1 replicated findings of previous research with a uniform updating task, indicating the difference in set size effects in the original studies was not simply due to the difference in their original tasks. Experiment 2 dissociated updating strategy from spatial representations. The updating strategy was manipulated via instructions, while the spatial representation was manipulated by whether varying the spatial layout in each set size trial by trial. The results of Experiment 2 suggested that updating strategy could be successfully manipulated and was flexibly associated with different spatial representations. In addition, the presence of set size effects depended on the spatial representation rather than updating strategy. These present findings undermined the two-system theory of spatial updating and supported the flexible updating-memory hypothesis.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 228

Perception and Action: Reaching and grasping

A novel diffusion-based model of choice reaching experiments

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Dietmar Heinke[1] (d.g.heinke@bham.ac.uk), Joo-Hyun Song[2]; [1]University of Birmingham, [2]Brown University

In long-standing research, previous studies have shown that reaching movements can be influenced by attentional selection processes. Critical evidence for this effect stems from reach trajectories in colour-oddity tasks. These experiments showed that the modulation of the reaching curvature is linked to colour priming i.e., colour repetitions lead to smaller curvatures compared to trials where target colour switches (e.g., Song & Nakayama, 2008; Moher & Song, 2016). Following this evidence, Heinke and colleagues developed a neurologically inspired robotics model for colour priming (Strauss et al., 2015). Critically, the model shows that in neural structures the attentional selection process easily leak into the motor system causing the curvature effect. Here, we present an alternative, simpler model which allows us to conduct quantitative investigations (e.g., model fitting) into the leakage effect. This novel model employs two diffusion processes (DP). (Normally DPs are used to model perceptual decision making.) Here one DP is assumed to capture the selection of the odd colour target (“attentional” stage) and “leaks” into the second

DP ("motor" stage). This motor DP can be seen to describe the noisy spatial progression of reaching trajectories and only begins when the perceptual stage reaches a threshold allowing us to model reaching latencies. Importantly, our simulation studies also showed that the curvature effect can be easily captured by this new model. Further simulation studies found that the model tends to exhibit correlation between reaching time and curvature. However, this result contradicts empirical findings. Interestingly, a simple modification of the model, additional feedback from motor DP to perceptual DP, allowed us to fix this problem. This feedback can be interpreted as a novel prediction for an influence of visual attention through reaching trajectories. In addition, we will present results from Bayesian model fitting underlining the potential usefulness of the model.

Acknowledgements: NSF BCS 1849169 and UKRI ES/T002409/1

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 776

Dissociating processes underlying cognitive control and value-based attention: A reach tracking study

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Mukesh Makwana[1], Jianfei Guo[1], Jacqueline Gottlieb[2], Joo-Hyun Song[1]; [1]Brown University, [2]Columbia University

Our abilities to focus on a goal while ignoring distractors (cognitive control), and to orient attention towards rewarding stimuli (value-based attention) are critical for survival. Cognitive control encompasses multistage processes such as conflict monitoring, response threshold adjustment, and response selection (Shenhav et al., 2013). However, little is known about how each process interacts with value-driven attention. To address this gap, we developed a modified Flanker task combined with a reach-tracking paradigm. Participants reached to a target on the right or left side of the screen as instructed by a central arrow that was flanked by congruent, incongruent or neutral distractors. To manipulate value-based attention, the flankers were rendered in colors that had pre-trained associations with positive, negative, or

no monetary outcomes. Previous studies suggest that, in the reach tracking paradigm, the initiation latency (time taken to initiate the movement after stimulus presentation) captures adjustments in response threshold, while the reach curvature (degree of deviation in the reach trajectory from the direct path to the target) captures response selection (e.g., Erb et al., 2016). We found that these two measures were differentially affected by distractor congruency and value. Initiation latency was reduced by congruent relative to neutral flankers, suggesting that congruency lowered response threshold. This reduction was attenuated by positive-reward compared to no-reward conditions. In contrast, curvature was increased on incongruent relative to neutral trials, suggesting that incongruent distractors interfere with response selection, and this effect was not affected by flanker value. Together, it appears that both congruent and incongruent trials modulate different cognitive control processes, response threshold adjustment and response selection respectively, whereas reward only modulates the former. Overall, this study uncovers the potential interactions underlying our cognitive control and value-based attention systems.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1250

Do deep networks encode a similar representation compared to a model of target kinematics during an interception task?

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Kamran Binaee[1] (kamranbinaee@mail.rit.edu); [1]University of Nevada, Reno

The current state of the art deep networks show superior performance over classic object recognition methods and in some cases, their accuracy surpasses the human level. However, it is not clear to what extent these deep networks are able to mimic the properties of the human visual system. Previous studies have reported resemblance between the human visual system and deep neural networks by visualizing the trained filters at each layer, however, there are studies that show significant differences between human performance and deep networks in the context of shape discrimination i.e. match-to-sample tasks that require a more complex representation of the object properties. Therefore, it is not clear how these networks perform when the representation is meant to be used for guiding the action i.e. hand movement to intercept a ball. In order to investigate this, we used the egocentric VR screen images from a previously

published Virtual Reality (VR) ball catching dataset where the subjects attempted to intercept a VR ball flying in depth. The images were fed to a pre-trained deep network and the extracted deep features were used to train an SVM regression model in order to reproduce the position of hand as ground truth. For comparison, a second SVM model was trained using the calculated features from the kinematics of the ball motion i.e. angular size, velocity, acceleration, and expansion rate. Our results show that the cross-correlation between the activation pattern of deep features and the kinematics features is highest in the first few initial layers of the deep network. This suggests that the initial layers of a deep network when compared to a model of target kinematics, encodes a similar representation of the visual information appropriate for guiding the movement of the hand for a target interception task.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

Hi, I'll be available via kbinaee@unr.edu and also the zoom link.
https://unr.zoom.us/j/3841966465
Feel free to shoot a message
Happy V-VSS!

Abstract ID: 1722

Explicit attention to allocentric visual landmarks improves memory-guided reaching.

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Lina Musa[1,2,3], Xiaogang Yan[1,2], J. Douglas Crawford[1-5]; [1]Centre for Vision Research, York University, Toronto, ON, Canada, [2]Vision Science to Applications (VISTA), York University, Toronto, ON, Canada, [3]Department of Psychology, York University, Toronto, ON, Canada, [4]Department of Biology, York University, Toronto, ON, Canada, [5]Department of Kinesiology, York University, Toronto, ON, Canada

The presence of an allocentric landmark can have both explicit (instruction-dependent) and implicit influences on reaching performance (Byrne and Crawford 2010; Chen et al., 2011 Klinghammer et al. 2015, 2017). However, it is not known how the instruction itself (to rely either on egocentric versus allocentric cues) influences memory-guided reaching. Here, 13 participants performed a task with two instruction conditions (egocentric vs. allocentric), but with similar sensory and motor conditions. In both conditions, participants fixated gaze near the centre of a display aligned with the right shoulder, and an LED target

briefly appeared (alongside a visual landmark) in one visual field. After a mask/memory delay period, the landmark re-appeared in the same or opposite visual field. In the allocentric condition, participants were instructed remember the initial location of the target relative to the landmark, and to reach relative to the shifted landmark. In the egocentric condition, subjects were instructed to ignore the landmark and point toward the remembered location of the target. To equalize motor aspects (when the landmark shifted opposite), on 50% of the egocentric trials subjects were instructed to anti-point i.e., opposite to the remembered target. When the landmark stayed within the same visual field, the allocentric instruction yielded significantly more accurate pointing than the egocentric instruction, despite identical visual and motor conditions. Likewise, when the landmark shifted to the opposite side, pointing was significantly better following the allocentric instruction (compared to motor-matched anti-reaches). This was true regardless of whether the data were plotted in allocentric (target releative-to-landmark) or egocentric (target-relative-gaze) coordinates. These results show that in the presence of a visual landmark, memory-guided pointing improves when participants are explicitly instructed to point relative to the landmark. This suggests that explicit attention to a visual landmark better recruits allocentric coding mechanisms that can augment implicit egocentric visuomotor transformations.

Acknowledgements: The Vision: Science to Applications (VISTA) program and the Canada Research Chairs Program.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1175

Grasping real-world objects along ambiguous dimensions is not biased by ensemble perception

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Annabel Wing-Yan Fan[1] (annabel.fan@mail.utoronto.ca), Lin Lawrence Guo[1], Adam Frost[1], Robert L. Whitwell[2], Matthias Niemeier[1], Jonathan S. Cant[1]; [1]University of Toronto Scarborough, [2]The University of British Columbia

The visual system extracts summary representations of visually similar objects which can bias the perception of individual objects towards the ensemble average. The visual system also plays a dominant

role in guiding action, which has been shown to resist the illusion-inducing backgrounds of classic pictorial illusions. These findings suggest that actions resist ensemble-based biases of visual scenes, in support of the view that different visual systems underlie scene perception and visually-guided action. Here we test whether ensemble statistics can influence visually-guided action when the target object's orientation, a crucial object feature for planning the hand's grasp posture, is visually ambiguous. To do this, we recorded the hand kinematics and electromyographic activity of ten participants who reached-out to grasp a circular 3D target that was placed in a background ensemble of 3D ellipses. Importantly, the average orientation and size of the ensemble was systematically varied (counter-clockwise vs. clockwise; small vs. large) across trials, with the prediction that ensemble statistics may affect grasping towards ambiguous (orientation) but not unambiguous (size) visual information. As a perceptual control, participants performed, in a separate block of trials, a manual-adjustment task in which they estimated the average size and average orientation of the ensemble displays. A univariate analysis using the kinematic data showed that neither the maximum grip aperture nor grasp orientation were biased by the average size and orientation of the ensemble displays, respectively, despite both summary statistics biasing their respective perceptual measures in the explicit estimation tasks. Furthermore, support vector machine classification of ensemble statistics achieved above-chance classification accuracy when trained on kinematic and electromyographic data from the perceptual but not grasping conditions, supporting our univariate findings. These results suggest that even along ambiguous grasping dimensions, visually guided behaviors towards real-world objects are not strongly biased by ensemble processing.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Feel free to reach out to me at annabel.fan@mail.utoronto.ca, or https://www.linkedin.com/in/annabelfan/

Abstract ID: 750

Representations for grasp-relevant parts of objects in the human intraparietal sulcus

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Maryam Vaziri-Pashkam[1] (maryam.vaziri-pashkam@nih.gov), Kristin Woodard[2], Leslie Ungerleider[3]; [1]Laboratory of Brain and Cognition, National Institute of Mental Health

Visual object representations have been found in both human occipitotemporal and parietal cortices. Here, we examined how these representations are influenced by the grasp plan. Participants viewed and grasped

3D-printed objects inside an MRI scanner. The objects were put on a table positioned over the body and the participants were able to view the object through a mirror. Objects were one of four mug-shaped items composed of a handle and a body and participants were instructed to grasp the handle. The handle (the grasp-relevant part of the object) was either straight or curved and the body was either round or rectangular. The experiment was a slow event-related design. Objects were put on the table behind an occluder; the occluder was lowered for 2 seconds so that participants would see the objects. The occluder was then raised back to cover the object and 8 seconds later the participants heard a beep instructing them to start the grasp without visual access to the object. This was done to separate the motor-related responses from the visual- and grasp plan-related responses. We focused on two shape-selective regions of interest: one in lateral occipital cortex (LOC) and one in the inferior intraparietal sulcus (inferior IPS). A pattern classification analysis was performed on the visual responses to discriminate either the two objects with the same body and different handles (handle classification), or the two objects with the same handle and different bodies (bodle classification). LOC showed similar classification accuracies for the body and handle, but inferior IPS showed significantly higher pattern classification for handles than bodies. These results demonstrate that grasp plans modulate the object response in the human intraparietal sulcus.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1512

Similar kinematics of grasping behavior across the hand and foot

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Yuqi Liu[1] (yl1179@georgetown.edu), James Caracoglia[1,2], Sriparna Sen[1], Erez Freud[3,4], Ella Striem-Amit[1]; [1]Georgetown University, [2]Boston University, [3]York University, [4]Centre for Vision Research, York University

Precision grasping is a highly prevalent everyday manual action. Previous studies have demonstrated that precision grasping is highly accurate and sensitive to object size. An outstanding question is whether the motor plan that guides these actions is hand-specific? Or, alternatively, can the same motor plan guide another body part that is less experienced in reaching and grasping in humans, such as the foot? We tested the kinematics of hand- and foot- grasping of blocks of different sizes in typically developed individuals. We measured the maximum grip aperture (MGA) and velocity as the hand and foot pre-shaped to grasp the blocks. Consistent with hand grasping, the maximum grip aperture of foot grasping linearly increases with block size, reflecting common preshaping mechanisms based on object size. In addition, the temporal

velocity profile is similar across the hand and foot. Taken together, these findings potentially indicate a single neural mechanism that drives grasping behavior across body parts.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1351

Similarity of objects based on the way they are grasped

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Kristin Woodard[1], Emalie McMahon[1,2], Maryam Vaziri-Pashkam[1], Leslie Ungerleider[1]; [1]National Institute of Mental Health, [2]Department of Cognitive Science, Johns Hopkins University

Most behavioral and functional MRI studies of object processing have focused on object categorization and labeling. Behavioral studies have explored the similarity between objects based on their semantic labels, while neural studies have compared the behavioral similarities to the representations in the visual cortex. However, categorization is not the only purpose of visual object processing. For example, when grasping an object, some aspects of its shape is relevant for planning the proper movement. To explore the grasp-based similarity of objects, we 3D printed a set of 58 natural objects and asked participants to grasp and hold the objects. We recorded the movements of the participants' fingers and explored the similarity between objects based on these movements. We used multi-dimensional scaling (MDS) to visualize the dimensions that explain most of the variance. The first two dimensions were jointly related to the orientation and size of the grasp-relevant part of the object. Changing the subjects' initial position from sitting to lying down and hiding the object when the grasp was performed did not systematically change the similarity matrices. Next, in an odd-one-out behavioral experiment performed online, we showed pictures of the same objects to participants in sets of three and asked them to pick the most distinct item. From these judgements we constructed a visual/semantic similarity matrix. Here, an MDS analysis showed that the first two dimensions were jointly related to the visual orientation and semantic labels of the object. The visual/semantic similarity was not significantly correlated with the grasp-based similarity suggesting separate features influence the two behaviors. These results could inform future fMRI studies exploring the brain regions involved in processing objects for the purpose of grasping.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1515

The assessment of visually guided reaching in prodromal Alzheimer's disease

Poster Presentation - *Topic area: Perception and Action: Reaching and grasping*

Alexandra G Mitchell[1] (alexandra.mitchell@ed.ac.uk), Stephanie Rossit[2], Michael Hornberger[3,4], Suvankar Pal[5], Robert D McIntosh[1]; [1]School of Psychology, Philosophy & Language Sciences, University of Edinburgh, [2]School of Psychology, University of East Anglia, [3]Department of Medicine, Norwich Medical School, University of East Anglia, [4]Norfolk & Suffolk NHS Foundation Trust, Norwich, [5]Anne Rowling Regenerative Neurology Clinic, Centre for Clinical Brain Sciences, University of Edinburgh

One of the first brain regions to show metabolic changes typical in Alzheimer's Disease (AD) is the precuneus (Dubois et al., 2014; Gordon et al., 2018). Focal damage to this brain area is known to cause deficits in reaching to objects in peripheral vision (Cavanna & Trimble, 2006; Karnath & Perenin, 2005). This impairment may therefore be present in individuals with AD, and even those with signs of pre-clinical AD, but no prior study has addressed this question. The aim of this study was to investigate the frequency and severity of peripheral misreaching in patients with amnestic Mild Cognitive Impairment (MCI) and typical AD, by comparison with age-matched controls (HC). We assessed both visually-guided reaching to peripheral and central targets, using two different tasks: lateral reaching in the fronto-parallel plane and reaching in radial depth. Both tasks were conducted on first their dominant and non-dominant side. Preliminary analysis shows no clear group-level difference in reaching accuracy. However, even the HC group showed a relatively high level of peripheral misreaching, compared to what is more typically seen in younger individuals (McIntosh, Mulroue, Blangero, Pisella, & Rossetti, 2011; Rossetti, Pisella, & Vighetto, 2003). Moreover, a small proportion of AD patients do show clear deficits, suggesting that there may be a subgroup of MCI and AD patients that develop peripheral misreaching.

Acknowledgements: This work is funded by the Dunhill Medical Trust

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

A published protocol of this project is available from BMJ-O (http://dx.doi.org/10.1136/bmjopen-2019-035021)

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Abstract ID: 1059

Perception and Action: Social and collective actions

Brain networks for visual self-recognition from whole-body movements

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Akila Kadambi[1] (akadambi@ucla.edu), Gennady Erlikhman[1], Martin Monti[1], Hongjing Lu[1]; [1]UCLA

Humans are able to identify self from body movements presented in the point-light display, despite little visual experience of seeing own actions. However, the neural mechanisms supporting visual self-recognition from body kinematics in actions remain unknown. Here, we utilized functional neuroimaging to examine which brain networks may support visual self-recognition from body movements. Eleven participants performed six simple actions (e.g., jump) and six complex actions (e.g., get attention), which were recorded by a motion capture system. One of each participant's friends (gender-matched) was also recruited to record the motion capture data for performing the same actions. After a delay period of 12 – 20 days, the participants ran a fMRI session in which they viewed point-light actions either performed by the participant self, or by the gender-matched friend or stranger. Participants were asked to make a self-recognition judgment among three choices (i.e., self, friend, or stranger). Each point-light action stimulus was present for 5 seconds. The experiment consisted of 144 trials. Accuracy in self-recognition from point-light displays (M= 0.48) was significantly above-chance. Brain activity was compared between self-action and stranger-action. We found that own-body movements activated bilateral IPL (key area of mirror neuron system, important for action goal identification) and bilateral TPJ (key area of higher-level mentalizing system, important for the explicit self-other distinction). Furthermore, we found that familiarity modulated right TPJ activity, with greatest neural activity for self, moderate activity for friend, and little activity for stranger. These results provide converging evidence that motor experience is critical for the construction of the bodily self. Specifically, the more effortful and controlled reasoning of the mentalizing system builds upon the automatically and reflexively recruited mirroring system for the construction of the hierarchical, multimodal self.

Acknowledgements: NSF BCS-1655300

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1719

Collective Motion in Human Crowds: Tests of the Weighted-Averaging Model

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Meghan Willcoxon[1] (meghan_willcoxon@brown.edu), William H. Warren[1]; [1]Brown University

What local interactions between pedestrians give rise to collective motion in crowds? Rio, Dachner & Warren (PRSB 2018) developed an experiment-driven model in which each individual aligns their heading direction (and speed) with a weighted average of their neighbors' heading (or speed), and the weight decays exponentially with distance. The model makes two assumptions: (1) a pedestrian's response is based on the average of neighbors within the neighborhood, and (2) walking speed and heading direction are controlled independently. We tested these assumptions in two experiments. On each trial, the participant 'walked with' a virtual crowd viewed in an HMD, and the walking direction or speed of 12 virtual neighbors was perturbed. Experiment 1 tested the averaging assumption by manipulating the distribution of headings (or speeds) in the virtual crowd. To dissociate the mean from the mode (4 neighbors with same motion), we varied the skewness of the distribution (normal, positive skew, negative skew). As the model predicts, we found no significant differences between heading distributions (BF01=8.46). In contrast, there was an effect of speed distribution ($p<.001$; BF10 = 42.15): final speed was faster when modal neighbors slowed down (negative skew). Surprisingly, the model yielded similar results, as it passed slower neighbors. Experiment 2 tested the assumption of independent control. We perturbed the heading, speed, or both, of a subset of neighbors and looked for crosstalk. Heading perturbations influenced participant speed, as pedestrians slow down slightly to turn ($p<0.05$) (Hicheur, et al. 2005). The combination of heading and speed perturbations also influenced participant heading: participants turned more when neighbors turned and slowed down ($p<0.05$). The model showed a similar response, because slower neighbors drift closer and thus exert greater influence. The results confirm both assumptions of averaging and independent control, and reveal how heading and speed are coupled through the world.

Acknowledgements: This research was supported by National Science Foundation (USA) grant NSF BCS-1849446.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 287

Doing vs. viewing: Common neural correlates of motor execution and body movement perception in EEG

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Alison Harris[1], Catherine Reed[1]; [1]Claremont McKenna College, Claremont, CA

Human body movements provide important information about the intentions and emotions of others, and growing evidence suggests that we understand others' mental states by internally recreating, or simulating, their external actions. Research using electroencephalography (EEG) has found reductions in oscillatory "mu" rhythms (8-14 Hz) over sensorimotor cortex both for executed and observed movements. Yet, because previous studies have compared a small subset of electrodes without controlling for visual and attentional factors, questions remain about the respective contributions of perceptual and motor systems to action simulation. Additionally, the effect of emotional content on mu suppression has been relatively unexplored, despite the putative role of action simulation in emotion perception. Here we used high-density EEG to directly compare brain activity associated with motor execution and action observation. In separate blocks, participants (n = 31) completed a finger-tapping task and observed point-light displays (PLDs) of emotional and affectively neutral body movements. Low-level motion information was controlled by contrasting biologically plausible coherent and scrambled PLDs, and attention was maintained through a continuous one-back monitoring task. Motor execution was associated with significant mu suppression (10-14 Hz) over sensorimotor cortex for finger-tapping relative to rest. Comparing action observation for coherent versus scrambled PLDs likewise revealed significant alpha-band suppression in central and frontal sensors, though the average peak frequency of mu suppression was significantly lower (action execution: 11.7 Hz, action observation: 10.8 Hz). Finally, contrasting emotional and neutral body movements, we found no significant differences in sensorimotor mu suppression, but significantly greater alpha suppression over occipital and parietal cortex, perhaps reflecting the greater attentional salience of emotional content. Together, these results generally support the role of sensorimotor systems in action simulation, both for neutral and emotional movements. However, we observed substantial individual

variation in the magnitude and distribution of mu suppression, suggesting an avenue for further investigation.

Acknowledgements: This material is based upon work supported by the National Science Foundation under Grant No. 1923178.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 436

Intention beyond Desire: Commitment in Human Action

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Shaozhe Cheng[1] (shaozhecheng@zju.edu.cn), Ning Tang[2], Wei An[1], Yang Zhao[1], Jifan Zhou[1], Mowei Shen[1], Tao Gao[2]; [1]Zhejiang University, [2]UCLA

Recent success of artificial intelligence is largely based on reinforcement learning (RL), in which an agent acts to maximize expected rewards. RL has deep roots in Psychology for modeling animal behavior and captures the fact that human actions are driven by desires. Nevertheless, it misses one mental representation highlighted by more recent cognitive Theory-of-Mind (ToM) models: Intention. Unlike desires, intentions form stable, partial plans of action concerning the future, demand “commitment” (Bratman, 1987). While having conflicting desires is part of human nature (e.g. losing weight and enjoying food), intentions should always be coherent, stable and admissible. Here we tested predictions of RL and ToM in a visual navigation task involving conflicting desires. A human or RL model controls an agent to reach one of two equally desirable restaurants in a 2D map. With a low-probability, random action noises can cause the agent to drift slightly. To test “commitment to an intention”, we created a special trial: once the agent clearly moves towards one restaurant, noises will push the agent away so that the alternative restaurant becomes a better “rational” choice. As predicted, the RL agent showed no commitment, with close to 0% still pursuing the original restaurant. In contrast, in 70% of trials, humans fought the noise and pursued the original restaurant persistently. In addition, humans form a commitment with deliberation. In the same task, we performed online prediction of the agent’s destination through well-established Bayesian ToM. The results demonstrated that while RL quickly displayed a preference, humans avoided showing any preference early on. In conclusion, humans are unlike RL in that they appreciate the gravity of

commitment, preferring not to rush forming an intention, but once committed, remain so despite setbacks. These results collectively demonstrate intention is an intrinsic mental representation that can forcefully regulate human actions through commitment.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1723

Intuitive Visual Communication Through Physical-Social Commonsense

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Stephanie Stacy[1] (stephanieestacy@gmail.com), Qingyi Zhao[3], Max Kleiman-Weiner[4,5], Tao Gao[1,2]; [1]Department of Statistics, University of California - Los Angeles, [2]Department of Communication, University of California - Los Angeles, [3]Department of Computer Science, University of California - Los Angeles, [4]Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, [5]Department of Psychology, Harvard University

Vision enables humans to communicate richly and flexibly. For example, pointing to the same object can represent go there or avoid that —opposite propositions— depending on the context. We construct a computational cognitive model that emulates the generative process of sending and receiving ambiguous signals. We argue that visually grounded physical-social commonsense is the key to resolving ambiguity in communication. Physical commonsense constrains the scope of actions due to the costs of interacting in an environment. Social commonsense treats observed behaviors as rational actions that maximize expected utility, given an agent's mind (e.g. beliefs, desires, and intentions). We augment the Theory-of-Mind (ToM) framework by treating signaling as a rational action. The signal's meaning is then defined as the contents of the mind rationally generating that signal, and inferred using Bayesian inference. In the context of multi-agent cooperation, the mind to interpret is a joint "we" mind, imagined separately by each agent. This "Imagined We" is constrained by the cooperative logic of being jointly committed to realizing a goal. Resolving overloaded signaling becomes possible because of constraints from (a) cooperative logic, (b) utility maximization, and (c) rational ToM Bayesian inference. Our model captures nuanced effects from two scenarios proposed in previous works where humans cooperate under overloaded signaling conditions. (1) When agents ask for help in the presence of multiple objects, even toddlers can disambiguate the referent of the request. (2) When agents communicate exclusively through tokens in an environment,

humans flexibly capture changes in token meaning as “go to” and “avoid” from context. Our model accurately reproduces both, observed distributions of signaling and signal interpretation, with a single free parameter – degree of rationality. As a general framework enabling agents to communicate flexibly and act efficiently under ambiguity, Imagined We generates many novel predictions that can be empirically tested.

Acknowledgements: This material is based upon work supported by the National Science Foundation Graduate Research Fellowship Program under Grant No. DGE-1650604.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1517

Investigating Cues for Perspective-Taking in Virtual Reality

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Morgan A. Saxon[1] (u1207852@utah.edu), Brandon J. Thomas[1,2], Jeanine K. Stefanucci[1], Sarah H. Creem-Regehr[1]; [1]University of Utah, [2]University of Wisconsin-Whitewater

Findings from the perspective-taking literature show individuals are good at understanding what can be seen from different perspectives, but less is known about how well individuals can judge possible actions from perspectives other than their own. In a previous study, we used a novel paradigm that combined a perspective-taking task with a reaching judgment in immersive virtual reality to investigate individuals' abilities to judge affordances when engaged in perspective taking. We also examined whether judgments were facilitated by the presence of a virtual human avatar. We found participants were generally faster at making a judgment when cued by an avatar versus an empty virtual chair. When the avatar was present, response times increased with disparity, showing a traditional mental rotation function that did not occur with the chair. In the current experiment, we tested whether this effect was driven more by the salience of the avatar as a cue or by the presence of an avatar body . Participants judged whether a ball on a table was reachable from their own perspective or from a different perspective around the table (90 to 270 degrees). Participants were cued to the new perspective with either an empty chair or a chair occupied by a cylinder. Participants responded whether the ball was most easily reached with their right or left hand, or not reachable. Preliminary analyses show participants were faster at responding when the cylinder was present versus when it was not, but the shape of the function for the cylinder was similar to what we saw for the empty chair in the previous experiment. The results suggest that both the avatar and cylinder increase the

salience of the cue, facilitating response time, but that there may be a unique contribution of the avatar to perspective taking in this task.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 767

Physiologically-inspired neural model for the visual recognition of social interactions from abstract and natural stimuli

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Martin A. Giese[1] (martin.giese@uni-tuebingen.de), Mohammad Hovaidi-Ardestani[1,2], Micheal Stettler[1,3];
[1]Hertie Institute / CIN, University Clinic Tuebingen

INTRODUCTION: Humans can perceive social interactions from natural as well as from highly impoverished stimuli, as shown by the classical experiments by Heider and Simmel. The neural circuits underlying this visual function remain completely unknown, and it has been suggested that the recognition of such stimuli is based on sophisticated probabilistic inference. We present a simple neural model, which is consistent with basic facts known about neurons in the visual pathway, that recognizes social interaction from naturalistic as well as from abstract stimuli. In addition, we present an algorithm for the generation of classes of naturalistic and abstract interaction simuli with full parametric control. Such stimuli are critical for electrophysiological experiments that clarify underlying mechanisms. METHODS: The model consists of a hierarchical shape-recognition pathway with incomplete position invariance that is modelled using a deep neural network (VGG16). The top-levels of the architecture compute the relative motion, speed and acceleration of moving agents in the scene, and classifies the interactions. Relative position is computed using a gain-field mechanism. The stimulus synthesis algorithm is derived from dynamic models of human navigation which are combined with methods for computer animation of quadrupedal animals. RESULTS: Classifying abstract interaction stimuli consisting of moving geometrical figures generated by the algorithm, we found reliable classification of 12 interaction categories. The model reproduces this classification and recognizes also interactions from real movies showing interacting animals. The model proposes a variety of neuron classes that are presently being searched for in onoing electrophysiological experiments. CONCLUSION: Simple neural circuits combined with learning are sufficient to account for simple forms of social interaction perception in real and artificial stimuli.

Acknowledgements: HFSP RGP0036/2016, EC H2020 CogIMon ICT-23-2014 /644727, BMBF FKZ 01GQ1704, BW Stiftung NEU007/1, KONSENS-NHE, NVIDIA Corporation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 993

Social Groups Increase the Influence of Neighbors In a Crowd

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Chen Zhou[1,2] (c.zhou.psy@gmail.com), William Warren[2]; [1]East China Normal University, [2]Brown University

Humans are social animals who communicate with each other even during locomotion, forming social groups within crowds. Social groups are reliably perceived based on head orientation and proximity, consistent with the social interaction field model (Zhou, Han, Liang, Hu, & Kuai, 2019). Previously, we found that a pedestrian follows a crowd by averaging the walking direction (heading) of all neighbors, with a weight that decays with distance (Rio, Dachner, & Warren, 2018). However, it seems obvious that we can follow a social subgroup (e.g. of friends). Here we investigate whether a social group is completely segmented, or affects the weight of neighbors in the group. Participants (N = 12) were instructed to "walk with" a virtual crowd of 9 neighbors while wearing a Samsung Odyssey HMD (FOV = 90˚ H). The virtual crowd contained (1) one subgroup of adjacent neighbors (A(R)=3) with their heads rotated toward each other, and (2) one subgroup of distractors (D=6) facing straight ahead. In each trial, one or both subgroups appeared and began walking; after 4-5s, the heading direction of one subgroup (A or D) was perturbed by ±10˚. The participant's final heading direction was measured as the dependent variable. In two control conditions, both subgroups appeared with heads oriented straight ahead, and one subgroup was perturbed (A(S) or D). There were thus eight conditions, each with 10 repetitions presented in a randomized order. The results show that participants did not segment the social group from the crowd, but were influenced by all neighbors. However, the social group (A(R) with rotated heads) had a significantly stronger influence on the participant's response (higher weight) than the asocial group (A(S) with straight heads) (p<.001). Future studies will try to incorporate the social interaction field model into the behavioral dynamics model to quantify the impact of social groups.

Acknowledgements: NIH R01EY029745, NSF BCS-1849446, China Scholarship Council

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please feel free to email me at c.zhou.psy@gmail.com if you have any questions.

Abstract ID: 825

The representational space of action perception

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Diana C. Dima[1] (ddima@jhu.edu), Tyler Tomita[1], Christopher Honey[1], Leyla Isik[1]; [1]Johns Hopkins University

Humans can easily extract meaning from complex actions, but the computations enabling this are not well understood. What are the organizing dimensions of human action representations? Their visual appearance? Their social content? It is likely that this rich behavioral space cannot be characterized with small-scale controlled experiments alone, but naturalistic stimulus sets pose additional challenges in disentangling the many potential contributing features. Here, we addressed this by first curating a large-scale set of ~200 three-second videos of everyday actions from the Moments in Time dataset (Monfort et al., 2019). We annotated the videos with relevant features, including action type and presence of a social interaction. The videos belonged to 17 action categories and were balanced in terms of environment, number of agents, and agent gender. Second, we used representational similarity analysis to evaluate how visual and social stimulus features predicted behavioral similarity measured via a video arrangement task. In a pilot online experiment using the Meadows platform, participants arranged a subset of 50 videos according to their similarity, broadly defined so as to emphasize natural behavior. Inverse multi-dimensional scaling (Kriegeskorte & Mur, 2012) was performed to calculate behavioral representational dissimilarity matrices (RDM) reflecting Euclidean distances between stimuli, which were correlated to model RDMs of predicted dissimilarity. These models were based on visual properties (such as convolutional neural network activations and spatial envelope) and social properties (such as action category, valence, number of agents, and presence of a social interaction). Social models (particularly action category and number of agents), but not visual models, explained a significant portion of the variance in behavior. Our results suggest that the behavioral space of action representation reflects socially relevant dimensions. This opens exciting avenues for disentangling the visual and social components of action recognition within a unified framework, using ecologically valid stimuli and computational models.

Acknowledgements: This material is based upon work supported by the Center for Brains, Minds and Machines (CBMM), funded by NSF STC award CCF-1231216.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1161

Watching others learn helps our own action generalization

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Miles Martinez[1], Tony Wang[1], Joo-Hyun Song[1]; [1]Brown University

Our ability to learn and generalize new motor skills is a fundamental aspect of human behavior. In previous work using a visuomotor adaptation task, we demonstrated that observational learning benefits the transfer of acquired motor skills to novel contexts (Martinez, Wang & Song 2019). Recent studies have shown that visuomotor adaptation relies on a combination of an explicit strategy, such as aiming, and implicit motor error reduction (Taylor, Krakauer & Ivry 2014). However, it is unclear how observation contributes to each of these components, and in turn, influences generalization. To address this question, we asked participants to perform three sequential visuomotor adaptation phases: observation, training and generalization. In the observation phase, each participant first watched a short movie in which an actor demonstrated a visuomotor adaptation task. Next, all participants performed the same training and generalization phases. Specifically, they adapted to a 45° cursor rotation to one target location (training), and then attempted to transfer their motor adaptation to untrained target locations (generalization). During these phases, we displayed a ring of numbers around the starting location, with the target location embedded at zero. The participants used this ring to report their aiming strategy. The presence or absence of this ring during observation was a between-subjects independent variable (ring vs. no-ring group). We found that the ring group generated a uniform aiming strategy across directions during generalization. The no-ring group created aiming strategies limited to the learned target location. Overall, these results suggest that visually congruent observation helps form an aiming strategy and determines how well this strategy can be transferred across contexts.

Acknowledgements: Project funded by NSF BCS 1555006

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 427

Weighted-averaging model of crowd motion generalizes to different turn angles and crowd sizes

Poster Presentation - *Topic area: Perception and Action: Social and collective actions*

Eugyoung Han[1] (eugyoung_han@brown.edu), Meghan Willcoxon[1], Trenton D. Wirth[1], William H. Warren[1]; [1]Brown University

From schools of fish to pedestrians on a busy street, it appears that collective motion emerges from local interactions between individuals. The crux of the problem is to understand these local interactions, including the rules of engagement and the neighborhood of interaction over which they operate. In Rio, Dachner & Warren's (2018) behavioral model, a pedestrian aligns their heading with a weighted average of the heading directions of all neighbors in the field of view (the rule), whose weights decay exponentially with distance (the neighborhood). The model was based on and fit to data with neighbors turning only ±10°. Here we test how the model generalizes to moderate turn angles of ±0-20° with fixed parameters (for large angles, see Wirth & Warren, VSS, 2017, 2019). In the first experiment, a participant (N=12) was instructed to "walk with" a virtual crowd of 12 virtual humans presented in a Samsung Odyssey HMD. On each trial, the crowd began walking forward; after 2-3s, a subset of neighbors (0, 3, 6, 9, or 12) turned left or right by 5°, 10°, 15°, or 20°. The participant's heading and speed were recorded. Mean final heading increased with subset turn angle ($p < .001$), as well as subset size ($p < .001$), confirming a proportional influence over this turn range. Mean final speed showed no main effects of turn angle or subset size, although there was a significant interaction ($p = 0.05$), indicating a slight slowing with a ±20˚ turn as subset size increases to maintain stability (Hicheur, et al. 2005). Next we plan to manipulate the size of the crowd to test whether neighbor influence is averaged or additive. The results indicate that the weighted-averaging model generalizes over a moderate range of turn angles.

Acknowledgements: Funding: NIH R01EY029745, NSF BCS-1849446

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 923

Perceptual Organization

Classifying perceptual grouping cues using interindividual differences

Talk Presentation - *Topic area: Perceptual Organization*

Timothy Vickery[1] (tvickery@udel.edu), Anton Lebed[1], Jordyn Loya[1]; [1]University of Delaware

Visual perceptual grouping is driven by a diverse set of known cues such as proximity, similarity, and common fate. The set of cues may be composed of different classes, such as 'extrinsic' cues (common region, connectedness) that depend on items' common relationships to third-party elements of a scene (e.g., a box that surrounds two dots groups those dots), and 'intrinsic' cues (similarity, proximity) that depend on features of the grouped items (e.g., two red dots group together if surrounded by green dots). However, these classifications heretofore relied solely on qualitative judgment and reasoning (e.g., Palmer, 1999). In this study, we exploited interindividual differences to probe relationships among grouping cues. In a 'Repetition Discrimination Task' (RDT; Palmer & Beck, 2007), participants (N=127) searched a row of alternating circles and squares for repeated items (two adjacent circles or squares) and identified the shape that was repeated. On each trial the row was grouped into pairs by one of seven cues (color similarity, proximity, common motion, temporal synchrony, common region, element connectedness, and induced perceptual grouping). Repetitions that span groups (between-groups) are found slower (slower reaction time, RT), on average, than those within-groups, an effect that scales with perceived grouping strength. For each participant and each grouping cue, we calculated an index of grouping strength (between-group minus within-group RT), and correlated effects across cues. Consistent with the existence of distinct cue classes, we found that effects of two 'extrinsic' cues (common region, element connectedness) and two 'intrinsic' cues (similarity and proximity) were the most highly correlated with one another. Hierarchical clustering analysis also suggested a broad distinction between extrinsic and intrinsic cues. Our approach suggests that grouping cues are indeed clustered into types that can be revealed through individual differences, which may be useful in guiding the construction of models of perceptual grouping.

Acknowledgements: NSF OIA 1632849

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Alternative link to presentation if site is too slow:
https://www.dropbox.com/s/oizn3dxii9r5yl0/VSS2020_final.mp4?dl=0
I'm sorry that I ran out of time to close caption my video. However, I have uploaded my slides as a

supplement. These slides have a transcription in the note section of each slide, of what I say on that slide. Please feel free to contact me directly at: tvickery@udel.edu

Abstract ID: 1089

Combined Effects of Multiple Scene Cues on the Perceptual Strengths of Promiscuously Interpolated Contours

Talk Presentation - *Topic area: Perceptual Organization*

Susan Carrigan[1] (susancarrigan@ucla.edu), Philip Kellman[1]; [1]University of California, Los Angeles

Previously, we presented work suggesting that the contour integration evident in path detection displays (Field, Hayes, Hess, 1993) is really revealing the intermediate output of the first stage of the contour interpolation process: a stage in which contours are interpolated indiscriminately across all pairs of relatable edge fragments. In a second stage, interpolated contours are evaluated in the face of information from a variety of scene cues – if the information from scene cues supports the existence of the interpolated connection, the connection will be maintained or strengthened. If it runs contrary to the interpolated connection, the connection will be weakened or deleted. Here, we utilize a novel paradigm, inspired by a figure from Bregman (1990), to measure the effects of cues in the second stage and to determine how information from multiple cues is integrated. Our 2AFC task utilizes stimuli consisting of fragments of randomly arranged alphanumeric characters; hidden within this noisy background is a subset of fragments that form a whole number or letter if the gaps between the fragments are filled in with interpolated connections. The task requires participants to find and recognize the whole letter or number. Doing so requires building up a complete object description from many real and interpolated edges. The results suggest that cues as to border ownership, and amodal surface spreading (both luminance contrast polarity and equiluminant color contrast) play a role in determining the final perceptual strengths of interpolated contours in stage 2. In addition, the results support the possibility that interpolation proceeds separately in different spatial frequency channels and that corroboration across channels is taken into consideration to determine the perceptual weights of interpolated contours in stage 2. Finally, the results reveal that, somewhat surprisingly, information from multiple cues is integrated in a simple additive fashion, with one interesting exception.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1276

Differential grouping affordances of random spatial and temporal information for accurate number estimation

Talk Presentation - *Topic area: Perceptual Organization*

Frank Durgin[1] (fdurgin1@swarthmore.edu), Elsie Aubry[1], JJ Balisanyuka-Smith[1], Çiçek Yavuz[2]; [1]Swarthmore College, [2]Haverford College

Magnitude estimates of spatial non-symbolic number are thought to follow a power function, like other psychophysical dimensions. However, existing data identifies a common transition point at about 20 dots: Below 20, mean estimates are typically accurate, with a slope of 1. Above 20, underestimation produces a power function with an exponent of 0.5 to 0.9. Here we ask whether the 20-dot transition point reflects a capacity limitation of a general number mechanism or the limit of a spatial grouping strategy. In a first study, we presented temporal sequences of clicks and/or visual flashes with random timing (minimum SOA 75 ms). The average event rates (6 - 8 Hz) precluded verbal counting. Forty-eight participants estimated the numbers of either auditory, visual, or audio-visual events (numbering from 2 to 58). For visual flashes, there was no evidence of special accuracy: Even in the subitizing range, mean estimates followed a power function with an exponent of 0.83 (R2 = .999). For auditory clicks, only the mean estimates for the numbers 2 and 3 were accurate, while a power function exponent of 0.84 fit the numbers beyond 3 (R2 = 1.000). For audiovisual events, mean performance was accurate only up to 4 events; beyond 4, data were fit with an exponent of 0.82 (R2 = .999). A follow-up study with 15 new participants, used hybrid spatiotemporal stimuli consisting of auditory clicks synched with accumulating visual items in a random spatial array that disappeared after the final click. Accurate mean performance in this hybrid condition reached about 11, beyond which estimates had an exponent of 0.70 (R2 = .998). When verbal counting is prevented and intervals are random, temporal numerosity followed a power function above 4. Random temporal processes less easily afford strategic grouping and subitizing than spatial displays, and this may limit accuracy.

This talk will be presented in Live Talk Session 6, Tuesday, 23 June, 7:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1659

Individual Differences in Perceptual Organization: Reanalyzing Thurstone's classic (1944) data and rediscovering factors for geometrical illusions, perceptual switching, and holistic 'Gestalt' closure

Talk Presentation - *Topic area: Perceptual Organization*

David Peterzell[1,2] (dpeterzell@berkeley.edu); [1]John F Kennedy University, [2]University of California, Berkeley

Thurstone's factor-analytic discoveries regarding primary visual abilities, gestalt effects, and perceptual dynamics seem clearly forgotten yet important for identifying and understanding processes underlying human perceptual organization. The present study used correlational and modern factor analytic methods to reanalyze the data of Thurstone (1944), which measured 194 individuals' performance on 60 visual tests. 11 Factors were deemed significant, and were varimax-rotated to simple structure. Visual factors were obtained for 1) geometrical illusions, 2) perceptual switch rates (i.e., between ambiguous binocularly rivalrous percepts]), and 3) holistic 'Gestalt closure,' among others. Some factors showed clear gender differences, while all were independent of general intelligence (and thus are 'specific abilities'). The three factors have now been replicated and 'rediscovered' in other large, classic data sets reanalyzed by the author. Discrepancies between factors obtained from these reanalyses and those from recent studies (e.g., those which find no common factor for illusions) are discussed. The visual factors that are determined by processing rate seem to differ from those obtained in visual tasks that are not time-limited. Reanalyses like these seem useful for identifying distinct visual-cognitive processes of interest to current vision researchers, as they use variability to link front-end visual processes to higher level perceptual and cognitive processes. Results are presented as part of a larger project, reanalyzing 11 classic visual studies by Thurstone and colleagues (1938-1957) as well as other available, relevant data (Carroll, 1993; Buckley et al, 2018) using modern, fast, improved factor analytic methods. In these reanalyses so far, broad general visual factors have not been found, nor have factors highly correlated with general intelligence been found. But it is evident that there are common factors linked to specific visual processes or abilities.

This talk will be presented in Live Talk Session 3, Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

My UC Berkeley email (listed on the abstract) is temporarily not functional. I don't use my JFKU email for vision-related correspondence. My best email is davidpeterzell@mac.com.

Abstract ID: 140

Local and global symmetry differentially affect complexity and aesthetics

Talk Presentation - *Topic area: Perceptual Organization*

Claudia Damiano[1] (claudia.damiano@kuleuven.be), John Wilder[2], Elizabeth Y Zhou[2], Dirk B Walther[2,3], Johan Wagemans[1]; [1]KU Leuven, [2]University of Toronto, [3]Samsung Artificial Intelligence Center Toronto

Symmetry makes stimuli less complex. Symmetric arrangements are also generally preferred to asymmetric ones. However, it is unclear whether these relationships depend on global mirror symmetry, or local parts symmetry. Here we investigate the roles of both local and global symmetry in subjective complexity and pleasure judgements of natural scenes. We collected subjective ratings of complexity, aesthetic pleasure, and interest for 720 scene images – approximately 50 ratings per image – using Amazon Mechanical Turk. We then calculated average complexity, pleasure, and interest ratings for each image, as well as several measures of local and global symmetry. Global symmetry measures were obtained by creating an axis of symmetry at every column (vertical) and row (horizontal) of the image, and correlating the rows/columns of pixels on one side of the symmetry axis to those on the other side, weighted by the proportion of rows/columns included in the correlation. Local symmetry measures were computed by converting each photograph into a line drawing and calculating the parallelism (ribbon symmetry) and distance (separation) between contours. To investigate the relationship between symmetry and participants' ratings, we ran a canonical correlation analysis using ten symmetry measures as predictors of the three subjective rating measures. The full model explained 35.1% of the variance shared between features and ratings. The first canonical root revealed that local symmetry measures, and vertical global symmetry, are negatively related to complexity ratings (i.e., symmetry reduces complexity). The second canonical root showed that horizontal global symmetry, and large variations in global symmetry within one image, are positively related to pleasure and interest. Our work suggests that global and local symmetry are distinct in their influence on people's judgements of pleasure and complexity: complexity is affected mostly by local aspects of the scene, while pleasure is influenced more by the scene as a whole.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
22 June, 8:00 am EDT America/New_York

Presenter's Message

Local symmetry papers I referenced in the talk:

1. Wilder, J., Rezanejad, M., Dickinson, S., Siddiqi, K., Jepson, A., & Walther, D. B. (2019). Local contour symmetry facilitates scene categorization. Cognition, 182, 307-317.

2. Rezanejad, M., Downs, G., Wilder, J., Walther, D. B., Jepson, A., Dickinson, S., & Siddiqi, K. (2019). Scene categorization from contours: Medial axis based salience measures. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (pp. 4116-4124).

And their GitHub: https://github.com/mrezanejad/SalienceScoresForScene

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Abstract ID: 372

Localization and Timing of Cortical Processes Related to the Use of Perceptual Context During Contour Detection: Evidence for Early and Mid-Latency Abnormalities in Schizophrenia

Talk Presentation - *Topic area: Perceptual Organization*

Scott Sponheim[1,2] (sponh001@umn.edu), Seung Suk Kang[3], Victor Pokorny[1], Michael-Paul Schallmo[2], Cheryl Olman[2]; [1]Minneapolis VA Health Care System, [2]University of Minnesota, [3]University of Missouri, Kansas City

Spatial context has a large influence on contour detection, but it is unclear when such context exerts influence on brain processes supporting perception. In the current work we investigated neural contributions to contextual influences on contour detection. Because schizophrenia is associated with poor contour detection and weak effects of perceptual context we also examined neurophysiological responses to identify abnormal mechanisms in the disorder related to contour perception. In a study of the diagnostic specificity and genetic relevance of perceptual context, we gathered electroencephalography (EEG) data from people with schizophrenia (PSZ) and bipolar disorder (PBP), as well as first-degree biological relatives of PSZ (RelPSZ) while they completed a contour detection task that included a manipulation of spatial context through shifting the orientation of elements neighboring the contour (i.e., flankers). A second study determined the likely cortical sources related to contour perception during the task. Event-related potentials (ERPs) derived from EEG revealed that occipital N1 and P2 responses were sensitive to perceptual context as was the central parietal P300 response. PSZ and RelPSZ showed reduced dependence on the orientation of flankers for contour detection and in their P300 responses, while PBP showed intact perceptual context effects but generally reduced ERPs. Cortical source estimations derived from MEG (guided by MRI) revealed that theta frequency responses at 125ms and 400ms within visual areas (V1, V3 and LO) were sensitive to contours and perceptual context. PSZ showed diminished responses in V1, V3, and LO that failed to be modulated by perceptual context. Results indicate that perceptual context influences early processing in primary visual cortex, and later responses in V1, V3, and LO. Schizophrenia

and genetic liability for the disorder are associated with alterations in the dependence of contour detection on perceptual context that may contribute to perceptual distortions central to the mental disorder.

Acknowledgements: VA Merit Review award 01CX000227 to SRS; NIMH award R24MH069675 to SRS; NSF GRF 00006595 to MPS, NIH awards T32 GM00847, P30 NS076408, P41 EB015894

This talk will be presented in Live Talk Session 8, Wednesday, 24 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 210

What is the function of the orientation-tilt illusion?

Talk Presentation - *Topic area: Perceptual Organization*

Thomas Serre[1] (thomas_serre@brown.edu), Drew Linsley[2], Junkyung Kim[3]; [1]Carney Institute for Brain Science, Department of Cognitive, Linguistic & Psychological Sciences, Brown University

Many visual illusions are contextual by nature. In the orientation-tilt illusion, a central grating's orientation is perceived as being repulsed from or attracted to the orientation of a surrounding grating. An open question for vision science is whether such illusions reflect basic limitations of the visual system, or whether they correspond to corner cases of neural computations that are efficient in everyday settings. Our starting point to investigate the computational role of the visual tilt illusion is the neural circuit model of classical (CRF) and extra-classical receptive fields (eCRFs) by Mely et al (2018). The model was constrained by anatomical and physiological data and shown to be consistent with a host of contextual illusions spanning visual modalities. We developed a machine-learning approximation of the circuit, which we call the feedback gated recurrent unit (fGRU), resulting in a recurrent circuit that can be embedded in modern deep neural network architectures. Unlike the original circuit, the fGRU implements hierarchical contextual interactions through task-optimized horizontal (within a layer) and/or top-down connections (between layers). We trained fGRU networks for the detection of object contours in natural scenes. They were found to be more sample efficient than state-of-the-art deep neural network models, while also exhibiting an orientation-tilt illusion consistent with human perception. Correcting this illusion significantly reduced model performance, driving a preference towards low-level edges over high-level object

boundaries. Overall, the present work provides direct evidence that the tilt illusion is a feature, not a bug, of neural computations optimized for contour detection.

Acknowledgements: This work was supported by ONR (N00014-19-1-2029), NSF (IIS-1912280), and the ANR-3IA Artificial and Natural Intelligence Toulouse Institute.

This talk will be presented in Live Talk Session 6, Tuesday, 23 June, 7:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 868

Perceptual Organization: Grouping, segmentation

Characterizing ensemble perception through variations in multiple statistical parameters

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Marco A Sama[1] (marco.sama@mail.utoronto.ca), Alexandria Maddix[1], Adrian Nestor[1], Jonathan S Cant[1]; [1]University of Toronto Scarborough

Many ensemble studies utilize uniform distributions, often with fewer than 10 items per set. This poses a challenge to real-world generalizability, given that naturally occurring ensemble distributions can contain many items and can vary considerably in shape. To that end, we evaluated the influence of set size and various statistical moments on ensemble processing. Across three experiments, participants viewed an ensemble of isosceles triangles with varying orientations for 250 ms. In Experiment 1, we examined the effect of varying set size (10, 20, 40, and 50 items) and range (60°, 90°, 120°, 150°, and 180°) on reports of average orientation for uniform distributions. Accuracy increased with larger set sizes and smaller ranges, with no interaction between the two distribution parameters. Next we evaluated performance using more naturalistic and differently shaped distributions. Specifically, we generated normally-distributed ensembles, and then changed their shape by manipulating skewness and kurtosis. In Experiment 2, participants had difficulty explicitly discriminating whether two ensembles had the same or different values of skew or kurtosis. In Experiment 3, we examined the effect of manipulating multiple distribution parameters (set

size, range, skewness, and kurtosis) on reports of average orientation. We again found no interaction between range and set size, but interestingly, participants had higher accuracy for leptokurtic compared with platykurtic distributions, and for skewed compared with non-skewed (i.e., normal) distributions, despite the lack of explicit sensitivity to these statistical moments in Experiment 2. Kurtosis interacted with both range and set size, but not with skew. Importantly, performance for skewed, kurtotic, and normal distributions was more accurate than performance for uniform distributions in Experiment 1. These results reveal the differential contributions of various distribution parameters on ensemble encoding, and, importantly, highlight the need to use naturalistic statistics over artificial uniform distributions when studying ensemble processing.

Acknowledgements: NSERC Discovery Grant to JSC, OGS to MAS

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

You can contact me through email: marco.sama@mail.utoronto.ca

Please include "VSS poster" somewhere in the email title. Thank you

Abstract ID: 1190

Common-onset visual masking reduces a simultaneous tilt illusion

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Tomoya Nakamura[1] (leventseleve0917@gmail.com), Ikuya Murakami[1]; [1]the University of Tokyo

Common-onset visual masking occurs when a sparse mask appears together with a target but remains after its offset. Several previous studies suggest that later sustained signals, possibly involving perceptual awareness of the target, are disrupted in this situation. On the other hand, the sustained signals are considered to integrate contextual information from surrounding space. Here we investigated how the contextual information about orientations of remote surroundings interacts with common-onset masking. We compared a repulsion effect of a simultaneous tilt illusion between simultaneous and delayed mask offset conditions. In the simultaneous offset condition, a target Gabor patch having a vertical grating and a surrounding four-dot mask were briefly flashed and disappeared together. In the delayed offset condition, the mask appeared together with the target, but remained there for 0.3 s after the target disappeared. This condition was suitable for common-onset visual masking to occur, but we optimized stimulus parameters so that the target was never rendered completely invisible. In both conditions, eight tilted Gabor patches were arranged circularly around the target, serving as inducers for the tilt illusion. Observers were asked to

indicate whether they perceived the target patch as tilted clockwise or counter-clockwise from the vertical. The repulsion effect was estimated as how many degrees the target patch appeared to be tilted away from the orientation of the inducers. We found that the repulsion effect occurred in both conditions but was smaller in the delayed offset condition than in the simultaneous offset condition. In contrast, discriminability of target orientation did not differ. It was also confirmed that the decrease of repulsion was not fully explained by the appearance of a subjective upright square seen in the four-dot mask. We suggest that the remaining mask can disrupt contextual modulation by surrounding space, while leaving low-level visual features of the target intact.

Acknowledgements: Supported by KAKENHI 18H05523

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please contact me by email at "leventseleve0917@gmai.com" if you'd like to get more detailed information.

Abstract ID: 450

Curvature of real and illusory contours across the blind spot and artificial gaps

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Yulia Revina[1] (yrevina@ntu.edu.sg), Man Ting Chay[1], Nicklaus Koh[1], Gerrit W. Maus[1]; [1]Nanyang Technological University

The blind spot's V1 representation receives monocular input only. Previous studies suggest that illusory contour (IC) interpolation through the blind spot is impaired compared to intact regions of the retina (Maertens & Pollmann, 2007) or scotomata (De Stefani et al., 2011). One explanation is that ICs require local signals to spread within monocular channels in V1. However, these studies used a shape discrimination task which might be less sensitive than tasks probing the contour directly, for example a dot localization paradigm (Guttman & Kellman, 2004). Here we used dot localization to test curvature perception of ICs and real contours (RC) across the blind spot. We presented curved ICs induced by Kanizsa-type figures or RCs, either through the blind spot or occluders. Additionally, ICs were shown uninterrupted (Control), while RCs were interrupted by a gap ("Deleted" condition). A dot briefly flashed near the contour midpoint. Participants judged whether it appeared inside or outside the shape. Psychometric functions for the proportion of "outside" responses as a function of dot position measured underestimation of curvature

and precision of contour interpolation. Generally, ICs were flatter than RCs. Crucially, blind spot ICs had the same precision and flatness as Control, suggesting intact representations of ICs across the blind spot. Occluded ICs had low precision and were completely flat. For RC, curvature was significantly flattened in the blind spot, but not in Occluded or Deleted conditions, suggesting modal contours are flatter than amodal. Using this more sensitive dot localisation task, our experiment found that ICs are represented across the blind spot in the same way as in other parts of the visual field, suggesting a monocular V1 region does not disrupt IC interpolation. Results also corroborate previous findings on modal and amodal curvature differences (Singh, 2004; Guttman & Kellman, 2004).

Acknowledgements: This research was supported by Nanyang Technological University starting grant awarded to Gerrit Maus (NAP-SUG).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Feel free to ask me anything via the chat and I'm looking forward to any comments or feedback :)
You can also contact me via yrevina@ntu.edu.sg and Twitter at https://twitter.com/Lingualsponge.

Abstract ID: 477

Different types of mental manipulation of visual number representations differentially impact representational precision

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Chen Cheng[1] (chencheng.psy@gmail.com), Melissa Kibbe[1]; [1]Boston Unviersity

Humans (and many animals) can rapidly extract approximate numerical information from visual arrays (e.g. sets of objects, dots, etc.). We also can update these numerical representations as new visual information comes in, summing over new input (akin to incrementing an “accumulator”). However, it is currently unknown whether manipulation of visual number representations is confined to accumulator operations, or whether different types of manipulations may differentially impact the precision of the outputs of those manipulations. We asked participants (n=24) to perform different manipulations over visual number representations. These manipulations involved representing an occluded array (Basic condition), summing two sequentially-presented arrays (Summation condition), or separately representing two arrays and then

taking their difference (Difference condition) (see Figure 1a). Crucially, both the Summation and Difference conditions required participants to manipulate two arrays, but only the Summation manipulation could be accomplished using an accumulator operation. We measured the precision of the outputs of these manipulations by asking participants to compare the outputs to a visible array of items, manipulating the difficulty of the comparison within each condition using five ratios (0.75, 0.8, 0.83, 0.86, 0.88). We observed a main effect of Ratio ($F(4,92)=14.07$, $p<.001$); participants were above chance (50%) for the first four ratios across conditions ($ps<.001$), but performance declined as the difficulty of the comparison increased. There was no main effect of Condition ($F(2,46)=.152$, $p=.859$), but there was a significant Ratio X Condition interaction ($F(8,184)=7.97$, $p<.001$); participants performed worse on Difference trials compared to both Basic and Summation trials when ratios were easier, with performance converging across the conditions as the task became more difficult (Figure 1b). These results suggest that visual number representations support a range of mental manipulations, but that the nature of the manipulation impacts the representational precision of its output.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1135

Ensemble of real-world objects: mean size estimation and bias from the real-world size

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Natalia Tiurina[1] (natalyatyurina@gmail.com), Yuri Markov[1], Anastasia Paramonova[1]; [1]National Research University Higher School of Economics, Russia

During ensemble representation of real-world objects do we rely only on pure "retinal" sizes or do some other properties of real-world objects matter? Real-world size is automatically encoded during object representation and influence on object size estimation. How could real-world size influence the mean size estimation of the set? We collected and tested stimuli set of images of real-world objects with small (e.g., cups, locks) and large real-world size (e.g., cars, houses). There were 15 categories with small and 15 categories with large real-world size (24 images per category). In Experiment 1, participants were instructed to estimate the mean size of set of eight objects belonging to one category. As a baseline, we presented the same sets, but instead of original images we used rotated black silhouettes. They had the same sizes as original images, but they had no color and texture, making them unidentifiable. Analysis with correction to

baseline demonstrated that the mean size of set of objects from “small” categories is underestimated in comparison to the mean size of objects from “large” categories. We conducted Experiment 2 to test whether the effect will be present when we eliminated the common category of the set and left only one common feature of the set – real-world size. Experiment 2 used the same procedure and design as Experiment 1, but we used three types of sets: objects from different “small” categories, objects from different “large” categories and “mixed” – objects from “small” and “large” categories. Analysis with correction to baseline demonstrated no significant differences between conditions. We conclude that real-world size could influence mean size estimation only if the set consisted of objects from one category, thus we propose that this bias is caused by the categorical level of set, but is not observed on the level of individual representations.

Acknowledgements: Funding: RFBR 18-313-00253

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1343

Event representations omit stretches of time

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Benjamin van Buren[1] (vanburenb@newschool.edu), J. Brendan Ritchie[2], Pascal Lefèvre[3], Johan Wagemans[2]; [1]The New School, [2]KU Leuven, [3]LUCA School of Arts

A large body of research has linked the ‘event structure’ of experience to core cognitive processes such as attention. For example, when subjects step through the frames of a movie in a self-paced slideshow, they dwell longer on certain frames, and these moments of greater attentional engagement turn out to be the same moments that subjects later mark as the ‘boundaries’ between successive events. An assumption in this method—and indeed, in most past discussions of event perception—is that event representations are perfectly contiguous, with each passing moment reflected in one representation or another. By contrast, here we asked whether event representations might actually omit stretches of time. Subjects placed markers on a movie timeline to indicate not the boundaries between events, but rather the start and end times of each event. Although subjects were encouraged to mark every event that they saw, large portions of each movie’s timeline (21%; around 8s of a 40s movie) were not included in any event interval. Why should this be? In a slideshow (completed prior to the event marking task), subjects dwelled less on frames that they later omitted from any interval, compared to frames that they later marked as starts, suggesting

lower-information moments may be omitted. We also investigated another form of event segmentation—comic artists' depictions of these same movies as sequences of drawn images. A second group of subjects indicated the first and last frames that each comic panel represented, again by placing markers on a timeline. This revealed that comics are a similarly sparse form of event representation, omitting on average 33% of their target movie, with omitted frames again occasioning lower dwell times than frames corresponding to the start of an event/panel. We conclude that event representations may omit time to a much greater extent than is typically acknowledged.

Acknowledgements: This research was supported by a Methusalem grant from the Flemish Government

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

For more information about the lab, please visit: http://gestaltrevision.be/en/

Abstract ID: 1536

From causal perception to event segmentation: Using spatial memory to reveal how many visual events are involved in causal launching

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Yifei Hu[1] (jerry4work@163.com), Joan Danielle K. Ongchoco[2], Brian Scholl[2]; [1]East China Normal University, [2]Yale University

The currency of visual experience is frequently not static scenes, but dynamic events. And perhaps the most central topic in the study of event perception is *event segmentation* -- how the visual system carves a continuous stream of input into discrete temporal units. A different tradition has tended to focus on particular types of events, the most famous example of which may be *causal launching*: a disc (A) moves until it reaches another stationary disc (B), at which point A stops and B starts moving in the same direction. Since these two well-studied topics (event segmentation and causal perception) have never been integrated, we asked a simple question: how many events are there in causal launching? Just one (the impact)? Or two (A's motion and B's motion)? We explored this using spatial memory, predicting that memory for intermediate moments within a single event representation should be worse than memory for moments at event boundaries. Observers watched asynchronous animations in which each of six discs started and stopped moving at different times, and (in different experiments) simply indicated each disc's

initial and final position. The discs came in pairs, and in some cases A launched B. To ensure that the results reflect perceived causality, other trials involved the same component motions but with spatiotemporal gaps between them (which eliminate perceived launching). The critical locations were the two intermediate ones (A's final position and B's initial position), and spatial memory was indeed worse for launching displays (perhaps because these locations occurred in the middle of a single ongoing event) compared to displays with spatiotemporal gaps (perhaps because these same locations now occurred at the perceived event boundary between A's motion and B's motion). This suggests that causal perception leads the two distinct motions to be represented as a single visual event.

Acknowledgements: BJS was supported by ONR MURI #N00014-16-1-2007.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 469

Measuring and Modeling Human Probabilistic Segmentation Maps

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Jonathan Vacher[1] (jonathan.vacher@einstein.yu.edu), Pascal Mamassian[2], Ruben Coen-Cagli[1]; [1]Department of Systems and Computational Biology, Albert Einstein College of Medicine, New-York, USA, [2]Laboratoire des Systemes Perceptifs, Departement d`etudes cognitives, Ecole normale superieure, PSL University, Paris, France

Visual segmentation is a core function of biological vision, key to adaptive behavior in complex environments. Early models inspired by the feedforward processing in the visual system described texture-based human segmentation as a comparison of the summary statistics of low-level image features across space. Here we consider the alternative view that, due to image ambiguity and sensory noise, perceptual segmentation requires probabilistic inference. To test this hypothesis, we develop a novel paradigm to measure perceptual segmentation maps and their variability. We use composite textures: each segment is characterized by a different distribution of oriented features. Participants briefly view an image followed by two spatial cues and report whether the cued locations belong to the same segment. We repeat the sequence with different locations and reconstruct the full segmentation map from the binary choices, solving a system of equations. In a second set of experiments, we manipulate uncertainty by controlling the overlap between feature distributions and smoothing the texture boundary and measure texture

discrimination performance. We find that segmentation maps are similar across observers but variable: perceptual variability correlates with intrinsic image uncertainty, and both are higher near segment boundaries. We then test the inference model that consists in assigning pixels to segments by evaluating which distribution explains best the observed features. Quantitative model comparison shows that perceptual variability reflects image uncertainty beyond sensory noise and that human segmentation is better explained by optimal probabilistic inference than by comparing summary statistics. Lastly, we find an interaction between the effects of contour uncertainty and feature distribution overlap. These results support the probabilistic inference hypothesis and suggest extending the model with contour specific components. Our work provides a normative explanation of human perceptual segmentation as probabilistic inference and demonstrates a novel framework to study perceptual segmentation, which could be extended to natural images.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

Hi and thanks for coming to my poster,

You can contact me by email: jonathan.vacher@einsteinmed.org
Don't hesitate to send a mail if you really want to discuss and you are not available during the scheduled zoom meeting.
You can find the rest of my work there: https://jonathanvacher.github.io

Jonathan

Abstract ID: 260

Orientation variance and spatial frequency modulate ensemble perception of orientation

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Hikari Takebayashi[1] (takebayashi@cv.jinkan.kyoto-u.ac.jp), Jun Saiki[1]; [1]Kyoto University

A great deal is known about the early steps of visual processing such as the orientation and spatial frequency (SF) channels, while little is known about how signals from those channels pool one another and generate statistical representations. Here we show different pooling mechanisms of orientation

information between high and low SF sinusoidal patterns. In the experiment, a set of 8-high SF gratings (3 cpd), 8-low SF gratings (0.8 cpd), or 4-high-4-low SF gratings located at the same eccentricity were randomly displayed for 250ms. Orientations of those individual gratings were jittered, and their variance was set either large or small. Observers reported the average orientation by adjusting a black bar to the point of subjective equality. We used response variability as a measure of orientation sensitivity, indexed by the concentration parameter of the von Mises distribution, with which high concentration means high sensitivity of average orientation. To get the 95% confidence interval about the concentration parameter for each condition, we generated 5000 bootstrap resamples about angular errors from the correct average. With a single object, orientation sensitivity was higher with high SF grating than with low SF grating. This high SF advantage holds in the averaging conditions with small orientation variance, but the pattern was reversed in the averaging conditions with large orientation variance, indicating that relative ensemble orientation sensitivity between high and low SF gratings is modulated by orientation variability. Moreover, the sensitivity in the 4-high-4-low SF gratings was lower than both in the 8-high and 8-low SF gratings, suggesting that the orientation signals from more than two different SF channels do not pool efficiently compared with the same or similar SF channels. The mechanisms underlying ensemble perception of orientation appear to be influenced by psychophysical characteristics in early visual processing.

Acknowledgements: JSPS KAKENHI Grant Number 16H01727

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1047

Perceptual Grouping Strategies in Visual Search Tasks

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Maria Kon[1] (mkon@purdue.edu), Gregory Francis[1]; [1]Purdue University

A subject may group stimulus elements in different ways using, e.g., size, shape, and proximity. Such groupings can be tuned to promote performance for a given task, e.g., look for nearby similarly shaped objects or for horizontally aligned equisized circles. Francis et al. (2017) showed how to tune a neural segmentation circuit to explain various uncrowding effects. The circuit could segment out flankers that did not group with the target, thereby freeing it from crowding effects. Here, we introduce methods to tune neural circuits for perceptual grouping and describe strategies that promote performance in visual search tasks. In the model, grouping occurs when illusory contours connect spatially separated elements. The

modified circuit allows for top-down control of a timing parameter that establishes the range of illusory contour formation. Separate top-down control of two size parameters prevents illusory contour formation for elements having too much or too little contour boundaries. We propose that subjects are able to tune these parameters for stimuli and tasks so as to group elements in a way that allows targets to be segmented from distractors. Within an experiment, the parameters can be changed to reflect previous failures to find the target, and strategic control of the parameters within a trial correspond to different search strategies that flexibly change groupings to promote target search. We show that when the model uses particular strategies, simulated results closely match human performance in visual search tasks where perceptual grouping is induced by proximity and shape similarity (Palmer & Beck, 2007) or by the spacing of irrelevant distractors and size similarity (Vickery, 2008). Thus, we show that the model accounts for a variety of grouping effects and indicates which grouping strategies were likely used.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

We are happy to answer your questions via chat or email (mkon@purdue.edu).

Although the walkthrough video is not captioned, we can email you a document with the text by request.

Abstract ID: 694

Task and Stimulus Dependent Contributions to Ensemble Scene Processing

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Vignash Tharmaratnam[1] (vignash46@gmail.com), Jason Haberman[2], Jonathan S. Cant[1]; [1]University of Toronto Scarborough, [2]Rhodes College

We recently demonstrated that summary statistics can be extracted for ensembles of multiple scenes (Tharmaratnam et al., VSS 2019), in addition to groups of faces and objects as shown in past literature. Specifically, participants integrated multiple scenes into their ratings of average scene content (i.e., perceived naturalness or manufacturedness) and spatial boundary (i.e., perceived openness or closedness), two global spatial properties (GSPs) important in scene perception. However, task difficulty increased with increasing set sizes, which was surprising given that ensemble perception usually becomes more efficient as set size increases. In the present study we conducted two experiments to explore whether this finding could be explained by either stimulus or task manipulations. In Experiment 1, scenes were divided into 6 parts (i.e., a 2x3 grid), and 1, 2, 4, or 6 parts were presented (in their corresponding grid positions) on each

trial. When rating average GSPs, we again found that task difficulty increased as set size increased, but also found that participants were integrating less information when encoding scene-part ensembles compared with the whole-scene ensembles used previously. In Experiment 2 we used the same whole-scene ensembles utilized previously but changed the task. Specifically, we randomly rotated the orientation of each scene in the ensemble and asked participants to rate the average orientation of the whole-scene ensemble. Similar to our previous results, we found that participants were integrating multiple scenes into their ratings of average orientation, but in contrast, we now found that task difficulty did not increase with increasing set sizes. Together, these results demonstrate that the efficiency of high-level ensemble scene processing is dependent on the nature of the stimuli (i.e., wholes vs. parts) and the type of summary statistic extracted (i.e., average GSPs vs. orientation), with potentially distinct ensemble mechanisms mediating average scene GSP and orientation processing.

Acknowledgements: NSERC Discovery Grant to J.S.C

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1292

The Outlier Paradox: The Role of Iterative Ensemble Coding in Discounting Outliers

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Michael Epstein[1] (mlepstein88@gmail.com), Jake Quilty-Dunn[2,3], Eric Mandelbaum[1,4], Tatiana Emmanouil[1,4]; [1]The Graduate Center, CUNY, [2]Oxford University, [3]Washington University in St. Louis, [4]Baruch College, CUNY

Ensemble perception has been shown to be resistant to the influence of outlier stimuli. However, outlier rejection is inherently paradoxical—how can ensemble processes disregard outliers, when outliers are defined based on ensemble properties? We propose that the solution is that ensemble perception operates iteratively, continuously updating and refining perceived summary statistics. We tested this hypothesis with three experiments. In experiment 1, participants reported the average orientation of groups of lines, in displays with or without outliers, using an adjustable probe. Extending prior results using facial emotion, the weight of outliers in reported averages was reduced, although error remained higher compared to conditions with no outliers present. In experiment 2 we directly tested the timing of this process using a

speeded response task. Here we found that responses were slowed significantly when outliers were present in the ensemble. In experiment 3 we tested the precise timing of outlier discounting, using masking at 50, 100, 200, 300 and 500ms post stimulus onset. Results showed that the influence of outliers on the reported average decreased linearly over time, with outliers seemingly rejected fully by 500ms. Altogether these findings support the hypothesis that ensemble perception works as an iterative process. The idea of ensemble perception as a continuously updating iterative process provides a useful explanatory framework for a number of findings: it bridges results that show ensemble perception is rapid with those that suggest it incorporates complex properties that require more extensive processing. It also sheds light on how statistics are collected from streams of stimuli, as well how summary statistics can guide attention towards or away from specific objects in visual scenes. We discuss the framework of iterative ensemble coding in the broader context of the literature and propose ways in which it can be rigorously tested using behavioral and neuroimaging experiments.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1472

The hierarchy of experience: Visual memory is differentially disrupted by local vs. global event boundaries

Poster Presentation - *Topic area: Perceptual Organization: Grouping, segmentation*

Joan Danielle K. Ongchoco[1] (joan.ongchoco@yale.edu), Brian Scholl[1]; [1]Yale University

Though static scenes so often dominate our experimental displays, our visual experience is inherently populated by dynamic visual events: out there in the world, things *happen*. And perhaps the two most salient themes in the study of event perception are *memory flushing* at event boundaries, and the *hierarchical* nature of our dynamic experience. Visual working memory appears to be effectively flushed at event boundaries (just as one might empty a cache in a computer program), perhaps because this is when the statistics of our local environments tend to change most dramatically — and holding on to now-obsolete information may be maladaptive for guiding behavior in new contexts. The series of events we experience arrives not as a linear sequence, though, but as a structured *hierarchy*, with global events built up from more local events. (A morning might involve showering, then breakfast — but breakfast might involve pouring coffee, then burning toast, etc.) Curiously, these two central themes of event perception

have never been connected, so here we explore for the first time how they interact. Observers viewed faces, one at a time. Certain features (such as size or spatial location) changed relatively frequently (inducing 'local' boundaries), while others changed less frequently (inducing 'global' boundaries). Critically, hierarchical position was dissociated from absolute frequency (such that a given frequency might be 'local' in one condition, but 'global' in another). On each trial, observers simply reported which of two faces had appeared first — where the pair could span a local boundary, a global boundary, or no boundary. Across a wide variety of experiments, memory was disrupted only by the most global boundaries that were present, regardless of their frequency. Thus, whether a particular event boundary will flush visual memory depends on how it is situated in the hierarchy of our experience.

Acknowledgements: BJS was supported by ONR MURI #N00014-16-1-2007.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 464

Perceptual Organization: Models and mechanisms

A comprehensive visual featural map in the human ventral temporal cortex

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

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Recent research on the ventral temporal cortex (VTC) has found clusters with differential preference to certain mid-level visual features such as rectilinear and curvature, which overlapped with the classical scene-preferring regions and face-preferring regions, suggesting a feature-based account for the seeming object domain-organization. This notion calls for a more comprehensive understanding of the visual feature topography in the VTC, considering the inter-correlation nature of different features, and its relation with the domain organization. We mapped out the sensitivity to 20 visual features (various visual shapes, color

hues, and Fourier power features) across all VTC voxels using a parametric modulation paradigm. The fMRI responses of 95 object photographs were collected in 29 individuals. Photograph computational vision models were used to obtain the weighting of the 20 visual features. There were 3 main findings: 1) Association between visual features and domain-preference VTC clusters: The full parametric modulation model (all variables entered simultaneously) showed multiple significant visual features clusters overlapped with the three domain-preferring regions (PPA for large objects, latFG for animals, LOTC for tools) (see Figure 1). 2) Association between visual features' VTC distribution pattern (beta values across the 3 domain-clusters) and the natural image statistics in the 3 object domains (weights in large image sets): Mixed linear model $F=13.49$, $p < 0.001$. 3) Visual feature effects independent of domains: Part of visual featural effects remained largely stable when the categorical structure was regressed out, and when presented in isolation as simple visual features. in experiment 2, the effects of the shape features (right angle, curvature) in the domain-preferring regions still remained whereas the effect of color hues disappeared. These findings depicted a comprehensive VTC visual feature topography map, which can be explained by their domain-associated natural image statistics, but with specific shape feature effects being domain-general.

Acknowledgements: This work was supported by the National Natural Science Foundation of China (31671128 to Y.B.), the 111 Project (BP0719032).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1029

Comparing representations that support object, scene, and face recognition using representational trajectory analysis.

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Aylin Kallmayer[1] (aylin.kallmayer@gmail.com), Jacob Prince[2], Talia Konkle[2]; [1]Goethe University Frankfurt, [2]Harvard University

Deep convolutional neural networks have become an increasingly powerful tool to probe the nature of visual representation in the primate visual system. With extensive training, these networks learn to transform pictoral inputs through several intermediate stages into a format that is optimized for a given task. To what degree do networks trained specifically on faces, places, or objects have similar or different

representational stages at each layer? Here we introduce a tool to visualize the "representational trajectories" that models take from input stages to output stages. Specifically, we trained models with a common base architecture (Alexnets) on either object categorization, scene categorization, or face identification. Next, we measured the responses in all units of each layer to a mixed probe set consisting of objects, scenes, and faces. Then, we computed the representational dissimilarity between all layers of all models. Finally, we used multidimensional scaling to plot layers with similar geometries close to each other, which provides a simple visualization of where along the processing stages models have similar and divergent representational formats. This trajectory analysis revealed that all three networks learned similar geometries in early layers, despite having different visual experience. The models diverged in mid and late layers, with object- and scene-trained networks learning more similar geometries than face trained networks. A randomly-weighted, untrained Alexnet showed no similarity to the other three network trajectories, indicating that the early representational similarity is not solely induced through a hierarchical architecture itself. Taken together, these computational results indicate that face, place, and object stimulus domains naturally share early and intermediate level image features, before diverging towards more specialized feature spaces. Further, this work introduces representational trajectory analysis as a comparative approach for understanding what is learned by deep neural network models across variations in architecture, training sets, and tasks.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 861

Comparison of generic convolutional networks versus biologically inspired networks as models of V4 neurons

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Michele Winter[1], Michael Eickenberg[1], Michael Oliver[2], Jack L. Gallant[1]; [1]University of California, Berkeley, [2]Allen Institute for Brain Science

Area V4 is an intermediate visual area for which no accurate computational models exist. Previous failed attempts to produce good V4 models were limited by the available neurophysiology data. Therefore, we performed long-term Utah array recordings in area V4 of two fixating macaques while presenting videos simulating saccadic eye movements over natural moving scenes. The resulting data set consists of over 400 neurons, each stimulated with up to several million video frames. We used two different types of neural

network models to predict V4 neuron responses to these video sequences: a baseline model adapted from convolutional networks typically used in computer vision, and a deep convolutional energy (DCE) model that incorporates prior knowledge about the structure of the primate visual system. To construct the baseline model each stimulus video frame was first passed through the standard VGG-16 pre-trained image classification network (Simonyan & Zisserman, 2014), and then consequent activations were regressed against neuronal responses at multiple temporal delays. The baseline model provides a lower bound on prediction accuracy that should be beaten by more realistic models. To construct the DCE model we architected a deep network consisting of several biologically-inspired components arranged in sequence: a log-polar transform; quadrature-pair filters; pooling into a second stage of quadrature-pair filters; and a final pooling stage. The neurophysiology data were then used to train this network. Training influenced the structure and distribution of quadrature pair filters and the pooling between layers of the network. Our results show that both the baseline and DCE models can accurately predict V4 neuronal responses even at the video frame rate (16.6 ms), the DCE model usually predicts responses significantly more accurately than does the baseline model. However, the baseline model performs surprisingly well given that the source features were extracted by a network trained independently from our experiment.

Acknowledgements: This work was funded by the following sources: NIH NEI R01 EY012241-05, NIH NEI R01 EY019684-01A1, ONR 60744755-114407-UCB, ONR N00014-15-1-2861, NIH National Eye Institute Training Grant T32EY007043

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 461

Ensemble properties are available more rapidly than individual properties: EEG evidence using the oddball paradigm

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

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Behavioral studies have shown that statistical properties of object groups are perceived accurately with brief exposure durations. This finding motivated hypotheses that ensemble perception occurs rapidly in vision. However, few neuroimaging studies have explored the timing of ensemble perception. Here we

used the superior temporal resolution of electroencephalography to directly compare the timing of ensemble processing to that of individual object processing. The P3b was chosen as a particular component of interest, as it is thought to measure the latency of stimulus evaluation. Participants performed a simple "oddball" task wherein sets of 51 lines with varied orientations sequentially flashed briefly on the display. In these sequences there was a 20% chance of an individual oddball, wherein one marked object tilted clockwise, and a 20% chance of an ensemble oddball, wherein the average orientation of the set tilted 20% clockwise. In counterbalanced blocks, participants were instructed to respond with a keypress to either individual or ensemble oddballs. Event-related potential analysis was performed to test the timing of this processing. At parietal electrodes, P3b components were found for both individual and ensemble oddballs. Ensemble P3b components were found to occur significantly earlier than individual P3b components, as measured with both 50% onset latency and 50% area measures. Using multivariate pattern analysis, ensemble oddball trials were classifiable from standard trials significantly earlier in their timecourse than individual oddball trials. Altogether, these results provide compelling evidence that ensemble perception is an early onset process within vision, and that strikingly these statistical summaries can be available even more rapidly than the properties of individual objects.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1613

Eyes converge during figure-ground perception

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

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Two cortical pathways are considered to be main components for performing basic operations in sensory perception such as figure-ground. Feedforward projections defining the classical receptive field properties of neurons detect visual elements and cortical feedback projections convey contextual influences beyond the classical receptive field. Previously we demonstrated that cortical feedback cannot explain all observed neural processes in figure-ground. In this study we show that vergence eye movements reflect figure-ground perception. The early onset (100-150 ms) of the slow vergence eye movement indicates that motor responses can influence perceptual processing during a prolonged period. The late (400-550 ms) discriminative vergence responses in figure-ground imply a cognitive role. Our findings may be important for the understanding of the neurobiology of visual perception.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 111

Learning visual contour tracing in a deep recurrent network based on a cortical columnar architecture

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Daniel Schmid[1] (daniel-1.schmid@uni-ulm.de), Christian Jarvers[1], Heiko Neumann[1]; [1]Ulm University

Problem. Visual segmentation mechanisms comprise rapid base grouping of simple features by pre-configured circuits and slower but more flexible incremental grouping by dynamically enhancing feature representations (Roelfsema, Ann. Rev. Neurosci., 2006). How can neural circuits for low- and intermediate-level vision learn such mechanisms? Deep learning provides a framework to develop neuroscience-related models, in which inductive biases constrain model computations (Richards et al., Nat. Neurosci., 2019). Here, we investigate the task of contour tracing to incrementally group visual items for decision-making in a reinforcement learning scenario (Roelfsema, Lamme & Spekreijse, Nature, 1998) with architectural constraints inspired by cortical columns. Method. We propose a multi-layer, recurrent, convolutional network where each layer is composed of retinotopically organized cortical columns. Such columns are modeled as pairs of interacting excitatory-inhibitory (E-I) neurons in discrete feature channels. E-I pair activations are computed from input filtering, lateral integration, activity normalization over neuronal pools, and top-down modulating feedback. Reinforcement signals are provided during training, from which the network can learn rewarding actions over sequential stimulus presentations, similar to the corresponding psychophysical experiments in monkeys, where the task is to fixate and hold gaze at a fixation cue and finally making a saccade to target items indicated by tagging via learned neural tracing. Results and Conclusion. The network successfully solves incremental grouping tasks after learning to act in accordance with the different phases of contour target presentation. Activity spreads along the target line to enhance its neural representation relative to a distractor. Inspection of the model reveals that maintaining fixations is mediated by E-I interactions, while the tracing operation that constitutes incremental grouping is mainly implemented by feedforward and recurrent excitatory interactions.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1216

Perceptual independence increases with depth in a generative adversarial network

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

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According to the efficient coding hypothesis (Barlow, 1959), neural coding serves to reduce statistical dependencies present in visual images, eliminating redundancies and thus yielding more compact perceptual representations. It has been shown (Kersten, 1987) that humans can invert these representations to generate accurate perceptual predictions of information missing in the image. Like the brain, Generative adversarial networks (GANs) learn a hierarchical representation that can be inverted to make predictions in the image domain. Here, we explore to what degree GANs can serve as a model for the progression in statistical independence seen in the brain. We do this by assessing the degree to which observers can estimate missing information at each layer of a Wasserstein GAN (wGAN). If the GAN's encoding of the image parallels our neural encoding, human ability to predict unit activations should decline from shallow layers near the image domain to deeper layers within the wGAN. Method: A wGAN was trained on CIFAR10. Images were generated by randomly sampling values in the latent layer, and then propagating activations through the network to the image. In each trial, a target unit in one of five layers of the wGAN was randomly selected for analysis. Observer estimates of target activations were identified with a nested adjustment task (Bethge, 2007) involving a telescoping sequence of image triplets. Each triplet was generated using three different values for the target unit, and observers had to select the image that appeared most natural. Results: We observed a systematic decrease in Pearson correlation between true and estimated values of target unit activations as we advanced from shallow layers near the image domain to deep layers, reflecting an increase in perceptual independence as a function of depth. Thus wGANs may form a reasonable model for the progressive elimination of perceptual redundancies in human visual coding.

Acknowledgements: NSERC Discovery Program

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 906

Perirhinal and Anterolateral Entorhinal Cortex Activity Patterns Reflect Perceived Visual Similarity of Highly Similar Objects

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Kayla Ferko[1,2] (kferko@uwo.ca), Anna Blumenthal[3], Chris Martin[3], Daria Proklova[1,2], Timothy Bussey[1,2], Lisa Saksida[1,2], Ali Khan[1,4], Stefan Köhler[1,2]; [1]University of Western Ontario, [2]Brain and Mind Institute, [3]University of Toronto, [4]Robarts Research Institute

Perirhinal Cortex (PRC) in the medial temporal lobe has been proposed to be an extension of the ventral visual stream (VVS; Murray, Bussey, Saksida, 2007). In support of this notion, evidence from numerous sources suggests that PRC supports discrimination of objects with high visual feature overlap. In the present fMRI study, we asked whether PRC activity patterns reflect the subjectively perceived visual similarity of objects, and whether these patterns are distinguishable at levels of similarity at which earlier VVS regions cannot distinguish between them. In addition, we investigated whether anterolateral entorhinal cortex (alERC), a region to which PRC projects, shows a similar response profile. We combined ultra-high resolution fMRI (isovoxel 1.7mm) in humans (N=23) with representational similarity analyses (RSA). Images of objects from multiple categories with differing degrees of visual similarity among exemplars were presented. We administered a variant of a 1-back task with catch trials that required identification of repetitions at the exemplar- and at the category-level. Participants also rated the perceived visual similarity in an inverse multi-dimensional scaling task (iMDS; Kriegeskorte and Mur, 2012). Behavioural results revealed sensitivity of performance on catch trials to variations in this similarity. RSA results of non-catch trials showed that patterns in early visual cortex, the lateral occipital region, PRC, and alERC (but not posteromedial ERC) correlated with participants' perceived visual similarity of objects within categories, as expressed in the iMDS. Importantly, only PRC and alERC patterns exhibited such a relationship at the highest level of similarities. Furthermore, PRC activity patterns showed a relationship to perceived visual similarity that was uniquely related to participants' own ratings. These findings suggest that the representational geometry of object representations in PRC and a downstream alERC region is tied to perceived similarity space, and that their fidelity is higher than in earlier VVS regions.

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Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1197

Predicting the functional organization of human visual cortex from anatomy using geometric deep learning

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Alexander Puckett[1] (pucketta@alumni.msoe.edu), Steffen Bollmann[1], Fernanda Ribeiro[1]; [1]University of Queensland

Human visual cortex is comprised of a number of areas, nearly all of which are organized retinotopically. This retinotopic mapping is similar across individuals; however, considerable inter-subject variation does exist, and this variation has been linked to cortical folding and other anatomical features. It was our aim to develop a neural network capable of learning the complex relationship between the functional organization of visual cortex and the underlying anatomy. Importantly, we used a geometric approach able to directly interact with data represented on cortical surface models, as many properties only make sense considering their location with respect to the various sulci and gyri. To build our network, we used the most comprehensive retinotopy dataset openly available – that from the Human Connectome Project. This dataset includes 7T fMRI data from 181 participants. The data serving as input to our network included curvature and myelin values as well as the connectivity among vertices forming the cortical surface and their spatial disposition. The output of the network was the retinotopic mapping value for each vertex of the surface model. Our final network included 12 spline-based convolution layers, interleaved by batch normalization and dropout. Our neural network accurately predicted the main features of both polar angle and eccentricity maps. More impressive yet, we show that the network was able to predict nuanced variations in the retinotopic maps across individuals. We further showed how disruption of the spatial organization of the input features increases the error and reduces the individual variability of the predicted maps. In conclusion, we were able to predict the detailed functional organization of visual cortex from anatomical properties alone using geometric deep learning. Although we demonstrate its utility for visual neuroscience, geometric deep learning is flexible and well-suited for a range of other applications involving data structured in non-Euclidean spaces.

Acknowledgements: This work was supported by the Australian Research Council (DE180100433).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
24 June, 2:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 928

Retinotopically Targeted Temporal Interference Stimulation to Human Visual Cortex

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Kathryn Devaney[1] (kdevaney@bidmc.harvard.edu), Sumientra Rampersad[2], David Beeler[3], Louis Vinke[3], Jing Xie[1], Marc Bouffard[1], David Somers[3], Daniel Press[1], Mark Halko[1]; [1]Harvard Medical School, [2]Northeastern University, [3]Boston University

Temporally interfering field stimulation (TI; Grossman et al. 2017) is hypothesized to use frequency summation to target deep brain structures, avoiding superficial structures. TI combines higher non-biologically relevant frequencies offset at a target neurologically relevant lower frequency, summing only at target locations. Efficacy of TI has previously been demonstrated in mouse motor cortex. Here, we report early findings assessing the safety and efficacy of visually targeted TI in humans. Following in silico modeling to determine targeting of the fields, four participants underwent population receptive field (pRF) retinotopic mapping and subsequent TI stimulation concurrent with a Humphrey automated perimetry visual field assessment. An area in right dorsal calcarine, corresponding to five degrees eccentricity in the lower left visual field, was targeted for stimulation. Electric fields were delivered at 1.5 - 2.0mA and 2Khz and 2.01KHz (i.e. a 10Hz offset frequency). Two perimetry examinations (a maximal 10 degree and a maximal 30 degree assessment) were performed before, during, and after stimulation, for six total assessments in each participant. TI was well tolerated in all participants and resulted in no measurable perturbation in visual perception as assessed with automated perimetry or a verbal post-stimulation interview. Taken together, the retinotopy, modeling & perimetry assessment demonstrates that targeted TI electrical field stimulation is safe in humans. The methods and experimental procedures, described here for the first time in human visual cortex, will inform future targeted TI stimulation experiments.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1282

Synthesizing images from deep neural networks to map the hierarchy of feature complexity in human visual cortex

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Jeffrey Wammes[1] (j.wammes@yale.edu), Kailong Peng[1], Kenneth Norman[2,3], Nicholas Turk-Browne[1]; [1]Yale University, [2]Princeton University, [3]Princeton Neuroscience Institute

Vision science often confronts the challenge of choosing stimuli that target particular stages of visual processing and whose similarity and structure can be quantified objectively. Here we leverage deep neural networks as crude approximations of the visual processing hierarchy to synthesize images containing features at any level of complexity and with a known representational structure in the model. We then validate this approach by using these stimuli during fMRI to localize areas of visual cortex with representations corresponding to different model layers. In a first study, we targeted object-selective visual areas such as lateral occipital (LO) cortex by synthesizing image pairs that varied parametrically in representational similarity in higher model layers. We found that pattern similarity across voxels in LO between paired stimuli mirrored the parametric increase in representational similarity in the model. In a second study, we extended this approach by synthesizing a single image set with the objective that the representational spaces for these images in different model layers would be uncorrelated. That is, for the set of images, the correlation of their unit activity patterns in a layer produced an image-by-image similarity matrix in each layer, and we sought images for which these similarity matrices were maximally orthogonal across layers. The resulting layer-specific representational fingerprints could be compared against the similarity matrices of patterns of voxel activity evoked by presenting these images, allowing visual areas and searchlights to be mapped precisely to model layers. Preliminary results suggest a hierarchical mapping, wherein lower layers are most strongly expressed in the occipital pole and higher layers are expressed laterally and anteriorly. These algorithms provide a new way to generate rich stimulus sets that can be formalized in a model and used to efficiently localize and differentiate even adjacent stages of visual processing.

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Presenter Conferences

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23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 556

The temporal dynamics of information integration within and across the hemispheres

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

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The human brain must integrate information across the left and right hemispheres to construct a coherent representation of the perceptual world. Characterising how visual information from the left and right visual fields is represented in the two hemispheres can inform information transfer in the brain. Previous work on this topic has focused on the dynamics of neural activation but it has been difficult to determine what information is being encoded within each hemisphere. Here, we investigated information processing within each hemisphere and the degree to which the information is distinct or redundant across hemispheres. We presented participants (N = 20) with images of faces, words and other objects in rapid serial visual presentation sequences while their neural responses were measured using electroencephalography (EEG). Crucially, stimuli were presented either centrally or lateralised to the left and right visual fields. Participants performed an orthogonal colour change task on three dots that marked possible image positions. Multivariate pattern decoding methods were applied to the EEG data to assess the coding of object information in the brain, separately for electrode clusters over each hemisphere. As expected, stimulus information was more robust and emerged earlier in the contralateral hemisphere than the ipsilateral hemisphere. Interestingly, the temporal dynamics of information within the contra and ipsilateral hemispheres followed different trajectories. We further showed that representational structure aligned across the two hemispheres at approximately 200ms. These results provide new insights into the dynamics of object perception and the competitive versus cooperative nature of hemispheric processing.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
21 June, 11:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1016

Visuospatial Object-Based Warping is Detectable in Early Visual Cortex

Poster Presentation - *Topic area: Perceptual Organization: Models and mechanisms*

Gennadiy Gurariy[1] (ggurariy@mcw.edu), Timothy J Vickey[2], Adam S Greenberg[1]; [1]Medical College of Wisconsin, [2]University of Delaware

In vision, objects constitute high-level percepts resulting from the spatial grouping of sensory information. Interestingly, it has been demonstrated that space within objects can appear systematically warped: items enclosed within an object are perceived further apart relative to equidistant items not enclosed within an object (Vickery & Chun, 2010). Here, we use functional magnetic resonance imaging (fMRI) to investigate the neural representation of object-based warping (OBW). First, participants adjusted perceived distances between two letters so as to match two reference letters either contained within an object, or not. This allowed us to compute the perceived “warping” of letter spacing due to OBW. Next, participants performed a discrimination task among four letters while fMRI data were collected in 3 conditions: (1) two letters were enclosed within an object, (2) two letters appeared without an object at the same visual field locations as in condition 1, and (3) two letters appeared without an object at the “warped” distances (calculated from behavioral data). Additionally, using a spatial position localizer, two regions of interest were defined corresponding to the retinotopic locations of letters within an object (real positions; conditions 1 & 2), and two regions corresponding to the “warped” positions (condition 3). Using neural activity extracted from each region, an MVPA classifier was trained on the difference between the two no-object conditions (conditions 2 & 3) and tested on the object-present condition (condition 1). Within ROIs corresponding to real spatial positions, the object condition was classified as “real” in V1 and “warped” in V2-V3. Within ROIs corresponding to the warped spatial positions, the object condition was classified as “warped” in V1-V3. This evidence of OBW in early visual cortex is likely driven by feedback from higher-level areas and suggests a fundamental change to visual perception caused by the presence of a simple object.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1421

Perceptual Organization: Patterns, shapes, objects

Children's perception of holes and wholes: Sound-shape correspondence for holes across development

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

Praveen Kenderla[1] (praveenk@bu.edu), Sung-Ho Kim[2], Melissa M Kibbe[1]; [1]Boston University, [2]Ewha Womans University

Children can count and track not only material objects but also non-physical entities, holes (Giralt & Bloom, 2000; Kibbe & Leslie, 2016). Using the Bouba/Kiki effect (in which both adults and children associate rounded shapes with the word "Bouba" and pointed shapes with "Kiki") as an implicit, direct measure of shape perception, we examined the development of the shape perception of holes in children. Adopting this methodological approach, our previous work (Kim, 2020) tested adults' sound-shape association for donut-shaped cutouts, one with a star-like hole (surrounded by rounded material bulges connected with sharp concavities; Figure 1) and the other with a flower-like hole (surrounded by pointy edges connected with rounded concavities). In both stimuli, the shapes of the interior (hole) and the exterior (figure) regions gave rise to opposite impressions (one rounded and the other pointed), and we found that sound-shape association was based on the shape of a hole rather than that of a surrounding figure, suggesting that holes have associated shapes despite their ground status in border ownership. In the current study, we tested 66 2-8-year-old children ($M=62.8$ months; $SD=19.9$ months). Children received one trial in which they were shown two cutouts and decided which one was either "Bouba" or "Kiki" (counterbalanced across subjects). We found that selecting the sound-shape-congruent hole was significantly correlated with children's age in months (Spearman's $r=.357$, $p=.003$). Older children (above the mean age) selected the sound-shape-congruent hole at rates significantly above chance (27/34 (79.4%), binomial test $p<.001$) similar to adults (Kim, 2020), while younger children selected the congruent and incongruent holes at roughly equivalent rates (17/32 (53.1%), binomial test $p=.86$; younger versus older: Fisher's exact test $p=.04$). These results suggest that the shape representations of holes require global shape processing which undergoes development between 2 and 8 years.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
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Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 337

Configural processing of 2D shape

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

Shaiyan Keshvari[1] (shaiyank@yorku.ca), Ingo Fruend[1], James H. Elder[1]; [1]York University

Background: Deep network models are relatively successful at predicting both performance and neural activations on object recognition tasks. However, recent work suggests that these models rely largely on local features rather than global shape, whereas humans, while sensitive to local 2D shape (curvature), are easily able to discriminate natural shapes from synthetic shapes with matched curvature statistics. Here we assess two alternative shape models that could account for this human sensitivity to 2D shape beyond local curvature: 1) Pooling – shape information is pooled over a collection of independently-coded fragments or parts; 2) Configural – the representation depends on the arrangement of these parts over the entire shape. Method: We employed a dataset of 2D animal shapes approximated as 120-segment outline polygons and local 'metamers' – closed contours that match the local curvature statistics of the animal shapes. In a two-interval task, five observers discriminated between a stimulus containing only animal contour fragments and a second stimulus containing only metamer fragments, while the length of the fragments was varied from 2 segments (local) to 120 segments (global). There were two conditions: 1. A single fragment displayed centrally. 2. Multiple fragments displayed within a 7.5 deg circular window. The number of fragments was selected to yield a total of 120 turning angles, matching the full-shape condition. Results: For both single- and multi-fragment conditions, performance rises from chance to near 100% as fragment length increases from 2 to 120, reflecting human sensitivity to 2D shape beyond local curvature. Interestingly, there is little difference in the psychometric functions for the single- and multi-fragment conditions (75%-correct thresholds of 24 +/- 7 vs 18 +/- 6 segments), indicating very little pooling across fragments. This suggests that human shape perception is highly configural, posing a challenge to recent deep learning accounts of object coding.

Acknowledgements: VISTA Postdoctoral Fellowship

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1647

Contour-object perception in psychosis

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

Rohit S Kamath[1] (kamat027@umn.edu), Kimberly B Weldon[1], Marisa J Sanchez[1], Cheryl A Olman[1], Scott R Sponheim[2,1], Michael-Paul Schallmo[1]; [1]University of Minnesota, [2]Minneapolis VA Medical Center

Visual contour integration, the process that represents spatially separated elements as a single unified contour, has been consistently found to be impaired in schizophrenia. Recent work suggests that this deficit could be associated with psychotic symptoms and not specific to a diagnosis of schizophrenia. We examined a transdiagnostic sample of 37 participants with psychosis, 25 unaffected first degree relatives, and 20 healthy controls as a part of the Psychosis Human Connectome Project. We obtained a behavioral index of contour perception by measuring orientation jitter thresholds in a psychophysical task. People with psychosis showed impaired contour perception (i.e., tolerating less contour jitter) in agreement with previous findings. People with schizophrenia also showed significantly lower accuracy in discriminating contour objects without jitter than people with bipolar disorder. However, we found no relationship between tolerance of jitter and severity of psychosis symptoms or level of disorganization, measured using the Scale for Assessment of Positive Symptoms, the Brief Psychiatric Rating Scale, and the Sensory Gating Inventory. We also used 7 tesla functional MRI (fMRI) to measure responses in primary visual cortex (V1) during an analogous task inside the scanner. Across participant groups, V1 fMRI responses were lower for aligned versus scrambled contours. This effect of contour alignment appears consistent with previous studies of predictive coding in visual cortex. Additionally, we quantified task-based functional connectivity using a psychophysiological interaction analysis. Preliminary results showed stronger functional connectivity between the lateral geniculate nucleus and V1 for aligned verses scrambled contour stimuli among healthy controls. Our results may suggest a relationship between abnormal neural response modulation in early visual cortex, and well-known impairments in visual contour perception among people with psychosis.

Acknowledgements: U01 MH108150, P41 EB015894, P30 NS076408

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for taking the time to check out my work!
I can be contacted at kamat027@umn.edu for any questions or such.

Abstract ID: 544

Perceived depth modulates the precision of visual processing

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

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Humans constantly use depth information to support perceptual decisions about object size and location, as well as planning and executing actions. Given the unique role of depth information in human vision, it has been proposed that perceived depth might influence visual processing. In particular, objects that are perceived as closer to the observer are processed by dedicated neural resources because they are more behaviorally relevant for both perception and action. Consistent with this proposal, there is evidence that shape discrimination is better for objects perceived as being closer to the observer. However, it is not clear from these studies if the reported processing advantage reflects changes in psychophysical sensitivity or bias. Here we evaluate whether visual resolution is modulated by perceived depth defined by 2D pictorial cues (perspective and size). In a series of experiments, we used the method of constant stimuli to measure discrimination thresholds for the length (Experiment 1) and orientation (Experiment 2) of pairs of lines. Just Noticeable Differences (JND) as well as Reaction Times (RT) were measured for pairs of stimuli positioned either on the 'near' or 'far' portion of the Ponzo Illusion, as well as a neutral version with no depth cues 'flat'. In both experiments, despite the fact that all stimuli were physically at the same distance, we found enhanced discrimination for objects perceived as closer in depth. Importantly, the improvement associated with location in depth was observed for both the JND and RT measures. Taken together, our results provide novel evidence that the location of an object in depth, as defined by pictorial cues, modulates the precision of visual processing.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1179

Prevalence effects on perceptual decisions: Category broadening, elevated miss rates, or both?

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

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How does the prevalence of the target influence perceptual decisions? Levari et al (2018) made 2AFC decisions as to whether a dot on a blue-purple continuum was blue. When blue items were less prevalent, observers were more likely to call ambiguous stimuli “blue”. They expanded their concept of blue (more liberal criterion). In contrast, Wolfe et al. find that observers become more conservative at low prevalence and find fewer targets in visual search experiments. What determines whether observers’ decision criteria become more liberal or more conservative when prevalence is low? In a series of replications of Levari’s study, we tested the effect of the response type (2AFC vs. Go/No-Go), color (blue-purple vs. red-green continua), stimuli type (solid color vs texture), and trial-by-trial feedback. Feedback appears to be the critical variable. In the presence of feedback, observers become more conservative at low prevalence. In the absence of feedback, they become more liberal, broadening the definition of less common target categories. Similar results were obtained with a shape continuum from rounded (“Bouba”) to spiky (“Kiki”). When Boubas are rare, ambiguous stimuli are called “Bouba” when there is no feedback. They are more likely to be called “Kiki” when there is feedback. There appear to be two, prevalence-based forces pushing and pulling decision criteria. These effects of prevalence have practical implications for low prevalence tasks like cancer screening. Do the pressures of prevalence cause experts to incorrectly categorize ambiguous stimuli as abnormal? In other work, multiple labs have shown that low prevalence causes experts to miss more targets. We will discuss whether category broadening and elevated miss errors might (unfortunately) coexist at low prevalence.

Acknowledgements: NEI EY017001

Presenter Conferences

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Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 720

Shape size judgments are influenced by fill and contour closure

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

David Burlinson[1] (david.burlinson@colorado.edu), Danielle Szafir[1]; [1]CU Boulder

Shape and size are two important visual channels that underpin our ability to reason about the visual world in settings ranging from natural scenes to informational charts and diagrams. Strong evidence in the vision science (Makovski, 2017) and data visualization (Smart & Szafir, 2019) literature suggests that shape and size perception are inextricably linked to each other, with asymmetric influences of either channel upon the other. To better understand these influences and begin exploring the visual features that contribute to them, we designed an experiment to address the following question: "how do people judge the size of simple 2D shapes varying in geometric properties at multiple scales?" We asked 82 subjects on Amazon Mechanical Turk to adjust different target shapes until they appeared the same size as an array of homogeneous background shapes, and collected response data on combinations of representative filled, unfilled, and open shape categories at three levels of size. We analyzed the delta between target and background shape size judgments using a generalized linear model, and found statistical significance for the role of size, target and distractor features, and the interaction of shape and size (all with $P < .001$). As shape size increased, the delta between target and background shapes decreased. In medium and large conditions, open shapes needed to be made smaller to appear the same size as filled or unfilled shapes, lending support to the open-object illusion. These findings have practical and theoretical implications. Visualization tools and designers would benefit from sets of symbols normalized for perceptual size at different scales; future studies can explore more situated tasks and contexts to that end. Furthermore, theories underlying shape perception should account for characteristics such as visual density, geometric properties, and contour closure, as these features produced significant differences in perceived size in this study.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1640

The Perception of Composite Fractal Environments

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

Emily K. Owen[1] (eowen@uoregon.edu), Kelly E. Robles[1], Richard P. Taylor[1], Margaret E. Sereno[1]; [1]University of Oregon

Natural scenery consists of objects built from self-repeating patterns, including clouds, mountains, and trees. Mandelbrot introduced the term "fractal" in 1975 to describe this family of objects. We rarely perceive one independent stimulus at a time in the natural world. Instead, we more often process layers of stimuli. Therefore, natural stimuli are better represented through layered fractal images. The current research behaviorally evaluates how we process layers of fractal information, otherwise known as composite fractals. The study utilized a within subjects design to examine the relationship between visual complexity, measured with fractal dimension (D), fractal type, and preference. Two types of fractal stimuli were created: a “mountain” fractal and a “cloud” fractal (see Bies et al., Symmetry, 2016). The experiment consisted of four blocks, with the first three using two-alternative forced-choice tasks in which pairs of fractals patterns of differing complexity were presented simultaneously and participants selected their preferred pattern. Block one paired mountain fractals, block two cloud fractals, and block three composite fractal stimuli consisting of a combination of a mountain fractal placed below and overlapping a cloud fractal of the same level of complexity. Block four had participants rate their preference for composite fractal stimuli with varying fractal dimension. The results indicated the highest preference for mountain fractals of D = 1.1, and cloud fractals of D = 1.7. For composite fractals with the same D, preference peaked at D = 1.5. The rating portion of the study revealed that there is significant preference for composite fractals where the mountain fractal is of lower complexity than the cloud fractal. We discuss the results within a fractal fluency model in which people have acquired their preference through exposure to prevalent fractal landscapes.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1402

The relationship between size illusion, physical size perception, and vernier acuity

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

Su Hyun Lee[1] (suhyunlee0916@gmail.com), Ju Hyeong Lee[1], Yoon Ji Jeong[1], Sung Jun Joo[1]; [1]Department of Psychology, Pusan National University, Busan, Republic of Korea

In the hallway illusion, the perceived size of the two objects with the same retinal size is affected by the three-dimensional spatial context in the image. Previous studies have shown that neural activity of V1 correlates with perceived size, not the physical angular size of objects. However, it is not clear whether there is a relationship between the individual magnitude of illusion and cortical activity related to the visual-spatial resolution. To answer this question, we used psychophysical tasks to measure the magnitude of illusion, size discrimination threshold, and vernier acuity threshold. Experiment 1 (n = 6) showed that the

magnitude of illusion did not change across different stimulus durations (100 ms versus 300 ms). Critically, even when the stimuli were masked after a brief stimulus presentation (100 ms), the magnitude of illusion was equivalent to the condition of the long stimulus duration without masking. In experiment 2 (n = 52), we measured the individual magnitude of size illusion, physical size discrimination threshold, and vernier acuity threshold. We found that the vernier acuity threshold correlated with the size discrimination threshold and the magnitude of size illusion. The smaller the vernier acuity threshold, the smaller the size discrimination threshold and the greater the magnitude of the size illusion. However, the size discrimination threshold did not correlate with the magnitude of the size illusion. Our results demonstrate that the size illusion is mediated by rapid visual processing such as V1 neural activity when the spatial context is presented, in which feedback signals might be already in place. Furthermore, our findings suggest that although physical size judgments and illusory size judgments are related to the cortical activity for hyperacuity, they might reflect different cortical mechanisms.

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Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1814

Toward a Science of Effect Size Perception: the Case of Introductory Psychology Textbooks

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

Sarah Kerns[1] (sarah.kerns@wellesley.edu), Heesu (Ally) Kim[1], Elisabeth Grinspoon[2], Laura Germine[2], Jeremy Wilmer[1]; [1]Wellesley College, [2]McLean/Harvard

In an increasingly data-producing world, effective visualization is an indispensable tool for understanding and communicating evidence. While vision science already provides broad cognitive guideposts for graph design, graphs themselves raise new constraints and questions that remain relatively unexplored. One central question is how the magnitude, or effect size, of a difference is interpreted. Here, we take several steps toward understanding effect size perception via the case example of college-level Introductory Psychology textbooks, selected for their reach to millions of students per year. A survey of all 23 major introductory textbooks found that graphs of central tendency (means) indicate distribution of individual

data points less than five percent of the time, and are thus formally ambiguous with regard to effect size. To understand how this ambiguity is commonly interpreted, we needed a measure of effect size perception. After multiple rounds of piloting (45 total rounds, 300+ total participants), we settled on a drawing-based measure whereby participants "sketch hypothetical individual values, using dots" onto their own representation of a given bar graph. Effect sizes are then read out directly from these drawings, in standard deviation (SD) units, by a trained coder. Next, we selected two textbook graphs for their large effect sizes of 2.00 and 0.70 SDs, and, using our created measure, we tested 112 educated participants. In their drawings we observed inflated, widely varying drawn effect sizes for both graphs, with median drawn effect size that were 200% and 1143% of the true effect size, and interquartile ranges were 100-300% and 714-2000%, respectively. The present work therefore documents an influential domain where the norm in graphical communication is formally ambiguous with regard to effect size, develops a straightforward approach to measuring effect size perception, and provides existence-proof of widely varying, highly inflated effect size perceptions.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1185

What's behind the curtain? Visual priming by draped objects

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

Patrick Little[1] (patlittle@jhu.edu), Chaz Firestone[1]; [1]Johns Hopkins University

Perhaps the most foundational assumption in perception research is that our experience of the world goes beyond the light reaching our eyes. This principle is familiar from visual illusions, perceptual constancies, and amodal completion — as when we perceive the continuity of an object behind an occluding surface. What is the limit to such phenomena? In particular, could we ever experience objects that are occluded completely? In fact, we frequently do: When a cloth or other fabric is draped over an object, we can often appreciate which properties the draped object might have, even when no part of the object is directly visible (Yildirim et al., 2016) — e.g., when a car is placed under a weather-protective covering, or when a child wears a bedsheet to dress up as a ghost. What is the nature of this experience? Do we only infer such hidden properties through thought and reflection? Or might we see such properties as part of automatic

visual processing? Here, we investigate this latter possibility using visual priming. On each trial, one of two volumetric shapes (e.g., a cube or sphere) appeared suddenly, and subjects indicated which shape was shown. Crucially, each shape was preceded by a brief ‘cue’: A rendering of one of the shapes with a cloth draped over it. There were thus two types of trials: congruent-cued and incongruent-cued. Even though this cue was completely invalid and task-irrelevant, it facilitated subjects’ responses: They were faster to report the identity of the displayed shape when its draped cue was congruent vs. when it was incongruent. We suggest that the mind automatically represents objects even when they reflect no light whatsoever onto our eyes, such that visual processing computes the properties of completely occluded objects.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1592

Will it fall?: Exploring the properties that mediate perceived physical instability

Poster Presentation - *Topic area: Perceptual Organization: Patterns, shapes, objects*

JunHyeok Kwak[1] (jun.kwak@yale.edu), Stefan Uddenberg[2], Brian Scholl[1]; [1]Yale University, [2]Princeton University

We often think of perception in terms of relatively low-level properties (such as color and shape), but we can also perceive seemingly higher-level properties, such as physical stability -- as when we can see at a glance whether a tower of blocks will fall or not. Prior work has demonstrated that physical stability is extracted quickly and automatically -- both by deep networks, and during human visual processing -- but it remains unclear just which properties are used to compute such percepts. In the current study, observers viewed pseudorandom 3D computer-generated images of block towers, such that the ground truth of each tower's stability could be simulated in a physics engine, and compared with observers' percepts of whether each tower would fall. Critically, towers were carefully constructed so that percepts of (in)stability could not be based on especially trivial properties such as global asymmetry, or the shape of a tower's boundary envelope. Our analyses demonstrate that observers are sensitive not only to whether a tower will fall, but also to continuous degrees of instability. In particular, the most powerful factor driving observers' percepts of instability was the summed distances that each block moved between the initial and post-fall tableaus,

independent of the towers' initial heights (even though of course observers never actually saw the towers falling) -- a factor that wasn't as salient in past models. Variance in the blocks' initial horizontal positions was also a powerful predictor of perceived (in)stability, independent of global symmetry. By combining psychophysics with physics-based simulation and computational modeling, these and other results help to reveal just how we can perceive physical (in)stability at a glance -- a capacity that may be of great adaptive value, given the importance in vision of predicting how our local environments may be about to change.

Acknowledgements: BJS was supported by ONR MURI #N00014-16-1-2007.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1750

Plasticity and Learning: Adaptation

Adaptation improves sensory encoding of visual orientation at but also perpendicular to the adaptor orientation

Poster Presentation - *Topic area: Plasticity and Learning: Adaptation*

Jiang Mao[1] (jiangmao@sas.upenn.edu), Alan Stocker[1,2]; [1]Department of Psychology, University of Pennsylvania, Philadelphia, PA 19104, [2]Department of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA 19104

Our perceptual system continually adapts to its sensory environment. As a result, both the neural representation of sensory information and perceptual behavior change with the adaptation state. However, it is unclear what fundamental principles guide these changes and how the perceptual and the neuronal changes relate to each other. Here we extracted the adaptation induced changes in neural representation from psychophysical discrimination measurements using an information theoretic approach. We determined discrimination thresholds for visual orientation after prolonged adaptation to a broad-band grating stimulus with oblique (45 deg) orientation and compared them to thresholds measured for a non-orientated control adaptor that was matched in all other stimulus aspects (4 subjects). We found that after adaption to the oblique grating, the thresholds at the adaptor orientation and, surprisingly, perpendicular

to the adaptor orientation were both substantially lower compared to the control condition. From these threshold measurements, we then estimated the adaptation induced changes in neural representation using an information theoretic bound (Cramer-Rao bound). Consistent with the threshold changes, encoding accuracy for orientations at and perpendicular to the adaptor orientation is higher than under the control condition, while it is lower in between. The efficient coding hypothesis suggests that the extracted change in neural encoding accuracy ought to reflect the difference in stimulus statistics between the adaptation and control experiment. We found that the increase in encoding accuracy at the adaptor matches the relative increase in stimulus frequency during adaptation and thus is in agreement with the hypothesis. The increase at orientations perpendicular to the adaptor, however, is not explained. Our results provide an empirical basis for a systematic investigation into how adaptation changes the interpretation of sensory information (i.e. decoding), in particular, whether the perceptual system as a whole is "aware" of adaptation induced changes in sensory representations or not.

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Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 603

Adaptation, Bayesian inference, and error correction

Poster Presentation - *Topic area: Plasticity and Learning: Adaptation*

Kara J. Emery[1] (karaemery@nevada.unr.edu), Michael A. Webster[1]; [1]Graduate Program in Integrative Neuroscience, The University of Nevada, Reno

Many perceptual effects have been successfully characterized within a Bayesian framework. Previously Stocker and Simoncelli (2006) used this framework to model sensory adaptation as an increase in the reliability of the measurement around the adaptor, leading to an asymmetrical likelihood function and the commonly observed aftereffects of repulsion and enhanced discriminability. We explored a Bayesian model of normalization aftereffects, in which the adapting stimulus appears more neutral or unbiased. This renormalization has been found for many stimulus attributes. We assumed the attribute is encoded by a uniform distribution of selective, labeled channels, and derived the likelihood functions from the pre- and post- adaptation channel responses. The prior corresponded to an unbiased stimulus and thus equal

responses across the channels. Adaptation to a biased stimulus (e.g. too weak or strong a response in a subset of channels) leads to a compensatory gain change that restores an unbiased response for the adaptor. This corresponds to a change in the mean (along the intensity axis) and width (along the attribute axis) of the likelihood function, and accounts for a wide range of adaptation effects including changes in sensitivity and contrast, renormalization, and both repulsive and attractive aftereffects when adapting to stimuli that are too strong or weak, respectively. The model also provides a principled prediction for the magnitude of the adaptation. By this account, adaptation updates the likelihood function in order to match a fixed prior, equivalent to the visual system trusting its assumptions and error-correcting its measurements.

Acknowledgements: Supported by EY-010834

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1500

Interocular transfer of distortion adaptation

Poster Presentation - *Topic area: Plasticity and Learning: Adaptation*

Yannick Sauer[1] (yannick.sauer@uni-tuebingen.de), Siegfried Wahl[1,2], Katharina Rifai[1,2]; [1]University of Tuebingen, [2]Carl Zeiss Vision International GmbH

Often optical devices cause distortions of the image perceived by humans affecting visual features in form and motion. In many cases, e.g. in progressive addition lenses, image skew is the prominent type of distortion. It is known that the human visual system adapts to skew distortion and shows form and motion aftereffects. In this study we investigate if motion direction aftereffects are also transferred to the other eye after monocular adaptation. In a psychophysical experiment natural image sequences skew distorted into one direction were presented to subjects monocularly. After the adaptation phase, aftereffects were tested in a motion direction identification task. A random dot test stimulus moved coherently into one direction either diagonally upwards or downwards. Subjects had to answer with their perceived motion direction. This way perception was evaluated before and after adaptation for the adapted as well as the non-adapted eye. The distorted image sequence was presented to the adapted eye in between test trials for top-up adaptation. The stimulus movement direction perceived as horizontal was estimated as through estimation of a psychometric function, separately for both eyes prior and after exposure to the skew adaptation stimulus. Results show a shift of motion angle perceived as horizontal for both eyes into the

direction of the distortion of the adaptation stimulus. In sum, after monocular exposure, aftereffects are transferred to the non-stimulated eye. Thus, skew adaptation can be assumed to occur at least partially in binocular areas.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 663

Repeated adaptation to red lenses produces stronger and more rapid effects

Poster Presentation - *Topic area: Plasticity and Learning: Adaptation*

Yanjun Li[1] (li000611@umn.edu), Katherine EM. Tregillus[1], Qiongsha Luo[1], Stephen A. Engel[1]; [1]UNIVERSITY OF MINNESOTA

The visual system adjusts its function in different visual environments. For example, when observers wear colored lenses, the lens color fades over time as vision adapts. It would be beneficial to adapt more rapidly to common environments. We tested if adaptation speeds up following repeated exposure to a colored environment. Twelve observers wore red lenses for 5 one-hour periods per day, for 5 days. We measured the time course of adaptation to the lenses twice daily. During testing, observers adjusted a 0.5-degree square on a naturalistic background to “unique yellow,” a chromaticity appearing neither reddish nor greenish. They first performed a five-minute block of settings under natural viewing. Then, observers put the lenses on and immediately performed another block, followed by others every 15 min for one hour. Testing began before observers first put on the glasses each day. They then removed and wore the lenses in alternation for 1 hr intervals, while going about everyday activities, before returning for a second session. Classical color adaptation was observed within each session; when observers first put on the lenses, unique yellow settings were relatively green, to cancel the redness the lenses produced. During the session, settings became less greenish, indicating that the world appeared less reddish over time. Critically, across days the mean setting of the very first block with lenses on became significantly less greenish ($t = 6.87$, $p < 0.0001$). This indicates greater rapid adaptation, with the world appearing immediately less reddish each day. Total adaptation, measured by the mean setting of each session’s final block, also grew across days ($t = 4.36$, $p < 0.002$). Both effects were still significant upon retest, one month later. Experience with colored lenses allows more rapid and stronger adaptation to the color shifts they produce.

Acknowledgements: NSF-BCS 1558308

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
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Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1516

Uncovering the physiological locus of the McCollough Effect using fMRI

Poster Presentation - *Topic area: Plasticity and Learning: Adaptation*

Katherine EM Tregillus[1] (kemtregillus@gmail.com), Karen T Navarro[1], Alexander Bratch[1], Stephen A Engel[1]; [1]Department of Psychology, University of Minnesota - Twin Cities

The McCollough Effect (ME) is a color afterimage produced by exposure to colored, oriented patterns. For example, following viewing of alternating vertical red and horizontal green stripes, vertical black and white patterns appear greenish, while horizontal black and white patterns appear reddish. The physiological locus of the effect has yet to be determined conclusively. We used fMRI and multivariate pattern analysis to identify neural loci producing the ME. We induced the ME with an augmented-reality-based method, wherein participants were exposed to a “McCollough World” of narrowband orientation-filtered video that appeared as black/green horizontal and black/red vertical stripes alternating every 2 sec. This caused a powerful ME amenable to study with neuroimaging. fMRI stimuli consisted of an array of circular square-wave grating patches that were either horizontal/vertical or diagonally rotated (45 deg/135 deg). Separate blocks displayed achromatic or red/green gratings for each orientation and color combination. Participants were scanned twice; once in a pre-adaptation scan, and once following two hours of adaptation in the “McCollough World.” Following adaptation, achromatic horizontal/vertical gratings appeared colorful. Distributed patterns of activation across voxels in early visual cortex were used to train a classifier to distinguish achromatic vs. red/green blocks in the pre-test, and this classifier was then used on the post-adaptation data. Classification results were above chance in the pre-adaptation scans, indicating that patterns of activity differed reliably between red/green and achromatic conditions. Classification of the post-adaptation data differed reliably from the pre-adaptation results, and followed more closely the perceived, not the veridical, color of the gratings. That is, following induction the physically black and white gratings were classified more often as red/green than as achromatic, matching observers’ percepts. This

provides evidence that the ME arises from changes in color- and orientation-selective neuronal populations in early visual cortex.

Acknowledgements: NSF-BCS 1558308

Presenter Conferences

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Presenter's Message

Contact Katie Tregillus at kemtregillus@gmail.com. I would be happy to provide a script for the video, or answer any questions you may have.

Abstract ID: 459

Plasticity and Learning: Categories, models, disorders

Cortical organization as optimization

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Nicholas Blauch[1] (blauch@cmu.edu), Marlene Behrmann[1], David Plaut[1]; [1]Carnegie Mellon University

The presence of category-selective areas in ventral temporal cortex (VTC) of humans and other primates has been used to support modular theories of perception containing separable components for the processing of categories such as faces and text. However, substantial evidence supports a non-modular, distributed account of processing containing topographic, graded specialization. Whether the developed system is best characterized as modular or not, a theory of its development is required. We performed small-scale abstract and large-scale visual recognition simulations to understand the development of specialization in tasks with varying degrees of functional overlap. Abstract autoencoder simulations revealed a small benefit from sharing hidden representations across orthogonal input domains – that is, from avoiding modularity. However, when the autoencoder was required to simultaneously encode inputs from both domains, it developed fully modular representations. By varying the fraction of inputs coming from a single domain or multiple domains, we could precisely control the degree of developed modularity. We next examined a deep convolutional neural network trained to recognize objects and faces. A fully shared network performed slightly better than architecturally modular networks matched in total units.

Further, the shared network developed substantial but graded specialization for objects and faces, with many units demonstrating domain-preferential mean responses and category-invariant information, while retaining such properties for the non-preferred domain. In ongoing work with a map-like deep convolutional recurrent neural network, we find that a simple and biologically-plausible scaling of connection noise or probability with axon distance may be sufficient to produce localized face-selective clusters. Our modeling approach demonstrates that graded, localized specialization may emerge from optimizing hidden representations for multiple tasks under architectural constraints, and that such graded specialization may be preferable to modularity even in the abstract scenario of representing orthogonal patterns. Our results thus weaken the case for full-fledged modularity in visual recognition.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1683

Effects of transcranial alternating current stimulation on visual cognition: A systematic review and meta-analysis.

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Breanna Bullard[1] (bbullard@bu.edu), Victoria Levina[2], Shrey Grover[1], Robert Reinhart[1]; [1]Boston University, [2]Yale University

Components of visual cognition are consistently related to brain rhythms of different frequencies. Transcranial alternating current stimulation (tACS) offers an opportunity to directly modulate brain rhythms of specific frequencies and potentially influence behavior. However, studies using tACS to investigate the nature of visual cognition in healthy humans have yet to be systematically reviewed, and it is unclear what stimulation parameters may be most effective at changing cognitive performance. Here, we conducted a meta-analysis of all peer-reviewed, sham-controlled, tACS studies seeking to modulate human cognitive performance on visual tasks. As of November 2019, 48 publications met our inclusion criteria. Effect size (Hedge's g) and 95% confidence interval were calculated for all primary outcome measures ($n = 129$) to evaluate differences between active versus sham stimulation. Pooled effect sizes were calculated for each targeted cognitive domain, demonstrating a significant effect of tACS on working memory ($k = 42$, $g = 0.280$, $p < 0.001$), executive control ($k = 21$, $g = 0.374$, $p < 0.005$), attention ($k = 16$, $g = 0.5196$, $p < 0.0001$), learning ($k = 16$, $g = 0.713$, $p < 0.0001$), and general intelligence ($k = 13$, $g = 0.497$, $p < 0.001$). Effect sizes

were calculated separately for studies that sought to impair visual cognitive performance (k = 17, g = -0.377, p = 0.05). The parameters of frequency band and stimulation location were significantly predictive of effect size magnitude. The results indicate that tACS may be an effective approach for bidirectionally steering visual cognitive performance in humans by capitalizing on the spatial and spectral properties of large-scale population activity.

Acknowledgements: R01MH114877, R01AG063775

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 541

Entraining Individual Alpha Oscillations Boosts Learning in Cluttered Visual Scenes

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Elizabeth Michael[1] (elizabeth.michael.88@gmail.com), Naomi Vaida[2], Blanka Zicher[3], Julia Heine[1], Victoria Leong[1,4], Zoe Kourtzi[1]; [1]University of Cambridge, [2]Trinity College Dublin, [3]University College London, [4]Nanyang Technological University (Singapore)

Learning to interact with challenging sensory environments is a key visual function. One form of challenge comes when observers are asked to identify a target object that is obscured by irrelevant, distracting information. Brain oscillations (i.e. periodic modulation of neural excitability) are known to contribute to the minimisation of distractor impact. Entrainment of such oscillations has been shown to modulate perceptual and attentional processes in the visual system. Here, we tested whether a flicker entrainment intervention targeting an individual's specific alpha frequency (8-12Hz) facilitates learning to detect a target in noise. Participants (n=80) were assigned to one of four groups. For the first 2 groups, entrainment pulses were presented at the individual alpha frequency for each participant and target stimuli were then aligned either to the peak (group 1) or the trough (group 2) of the induced oscillation. Group 3 was tested with the entrainment frequency mismatched (i.e. +/- 1 Hz) with the individual participant's alpha frequency, while Group 4 was tested with non-periodic pulses (no entrainment control group). We found significantly higher learning rates for group 2 compared to all other groups; that is, when entrainment pulses matched the participant's individual alpha and the stimuli were aligned with the trough of the oscillation. Further, we tested the effect of individualised entrainment on brain oscillations as measured by

electroencephalography (EEG) data during training. Phase of stimulus presentation (group 1 vs. group 2) elicited differences in the early stimulus-locked response, related to stimulus processing, while individualized rate of entrainment (group 2 vs. group 3; matched vs mismatched) produced differences in cross-frequency band synchronisation. These results suggest a cascade of neural interactions related to learning and propose an important role for individualized entrainment in learning interventions.

Acknowledgements: Supported by the Wellcome Trust (206495/Z/17/Z - awarded to EM), Biotechnology and Biological Sciences Research Council (BB/P021255/1, to ZK) & Wellcome Trust (205067/Z/16/Z, to ZK).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hi! If you would like to get in touch, you can email: em639@cam.ac.uk.

Abstract ID: 1129

Expert tool users do not visually embody their hand-held tool

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Hunter Schone[1,2] (schonehunter@gmail.com), Roni Maimon Mor[2,3], Chris Baker[1], Tamar Makin[2]; [1]NIMH, National Institutes of Health, [2]University College London, [3]University of Oxford

The idea that when we use a tool we incorporate it into our body representation (‘embodiment’) has been a major inspiration for science and innovation. Here, we use the visual hand representation to test the tool embodiment theory. Previous work has shown that amputees that use a prosthetic hand represent their own prosthesis more dissimilarly to real hands in visual cortex, compared to controls, challenging current views of prosthesis/tool embodiment (Maimon-Mor & Makin, 2020). It remains unclear, however, whether this is a common representational feature of expert use for any tool. We investigated whether able-bodied expert tool users visually embody their expert tool (e.g. represented more like a hand), compared to novices. We used Representational Similarity Analysis of fMRI data from 7 expert litter pickers and 12 novices. Participants viewed first-person grasping videos of hands, litter pickers and a non-expert grasping tool in an event-related design. A region of interest in occipitotemporal cortex (OTC) was independently localized by contrasting action videos of hands and tools vs. objects and abstract visual information, acquired on independent data. We found that expert tool users represent their expert tool more dissimilarly to hands, compared to novices ($t(18)=-3.202$, $p = .005$). Instead, expert tool users represent both grasping tools (expert and non-expert) more similarly to each other, compared to novices ($t(18)=-2.271$, $p = .009$). Like the expert tool, experts also represent the non-expert grasping tool more dissimilarly to hands, compared to novices ($t(18)=2.948$, $p = .036$). Together with our previous findings in prosthesis

users, our results suggest that expert tool use, be it a prosthesis or a hand-held tool, leads to greater dissociation of the tool from the visual hand representation. Furthermore, our findings extend previous evidence for experience-dependent plasticity of functional representations in OTC.

Acknowledgements: This work was supported by an ERC Starting Grant (715022 EmbodiedTech).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York

Presenter's Message

Feel free to contact me if you have any questions or want to schedule other times to discuss the work.
hunter.schone@nih.gov

Abstract ID: 777

Gabors in Bad Places: Early Visuocortical Population Responses to Aversive Spatial Conditioning

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Wendel Friedl[1] (wfriedl@ufl.edu), Andreas Keil[1]; [1]University of Florida, Department of Psychology

Visuospatial information processing capabilities need to be experientially malleable in order to enable sighted organisms to adapt to dynamic environments. This work examined visuocortical changes at the neuronal population level as human observers learned to associate specific spatial locations with aversive outcomes. High-density EEG was recorded while 50 healthy undergraduate students viewed individually presented, high-contrast Gabor patches appearing at one of five different locations. Patches were flickered to produce steady-state visual evoked potentials (ssVEPs) at a temporal frequency of 15 Hz, with one of the spatial locations (manipulated between-participants) paired with an aversive 90 dB white noise auditory stimulus for the final 200 (out of 350 total) trials. Alpha band (9.6 – 13.2 Hz) and ssVEP signals were source-localized via minimum norm estimation, and amplitude changes following conditioning were evaluated for trends consistent with either sharpening (i.e. lateral inhibition; amplification of the conditioned location and suppression of nearby locations) or generalization (amplification of the conditioned location, with amplitude gradually decreasing with increasing distance) across the five spatial locations. Indexed by ssVEP amplitudes, conditioned locations sharpened responses in retinotopic visual cortex, with stimuli presented in the left visual field eliciting the most pronounced changes. Alpha-band power reduction, often associated with the engagement of attention and alertness/arousal mechanisms, was also most prominent when viewing Gabors at locations paired with the noxious noise. Results suggest that learning to associate

spatial locations with aversive outcomes prompts both sharpening of retinotopic visual field representations as well as the selective engagement of higher order, endogenous biasing mechanisms indicated by alpha-band power reduction.

Acknowledgements: This work was supported by the National Institutes of Health, grants R01 MH112558 and R01 MH097320 to AK.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1170

Modeling effects of blurred on vision on category learning

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

William Charles[1] (wcharles1@fordham.edu), Rohan Agarwal[2], Daniel Leeds[1]; [1]Fordham University, [2]Hunter College High School

Human visual acuity sharpens during the first several months of life. Changing eye shape causes vision to develop from 20/800 to 20/20 over these months. Visual object learning develops in tandem with visual acuity. Children with congenital cataracts removed after months of visual development show impairments in a variety of visual tasks, including integration of contour segments (Putzer 2007) and facial recognition (de Heering 2002). Recently Vogelsang (2018) reported a benefit for face learning in the AlexNet Convolutional Neural Network (CNN) when training first on blurred images followed by clear images. We explore effects of blurred vision on broader object class discrimination, compared against fine grained dog breed discrimination. We test the bounds of advantageous blurring. We train CNN models (including AlexNet and Squeezenet) on two image datasets drawn from Imagenet (Russakovsky 2015): “Imagewoof” features ten breeds of dogs, and “Imagnette” features ten visually distinct object types. CNNs were trained after Xavier initialization using images with each of five Gaussian blur settings – windows of 1, 3, 5, 11, and 23 pixels. These windows capture the span of visual acuities over development. We test each network separately on images from each blur level, using five-fold cross validation. We find networks perform best when trained and tested on the same level of blur. Notably, training with higher-blur images allows relatively robust recognition for lower-blur images, while lower-blur learning does not equivalently benefit higher-blur recognition. The benefits of blur training extend to the highest blur training windows for object recognition, but are confined to smaller levels of blur (3 and 5 pixels) for dog breed discrimination. These benefits were more pronounced in the larger AlexNet architecture, compared to Squeezenet. Our findings

support the utility of learning from blurred images for broad object recognition, particularly in larger networks.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 833

Properties of the “Preferred Retinal Locus” in Response to Asymmetrical Progression of Simulated Central Scotomas

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Quan Lei[1,2], Susana T.L. Chung[1]; [1]University of California, Berkeley, [2]Wichita State University

People who lose their central visual field in both eyes often adopt a peripheral retinal region, the preferred retinal locus (PRL), for seeing. Although the progression of vision loss is often asymmetrical between the two eyes, little is known about how an adopted PRL responds to changes in the central scotoma in one eye. In this study, we used a gaze-contingent paradigm to simulate the presence of central scotomas in the two eyes and examined how a “PRL” might change in response to the enlargement of the simulated scotoma in one eye. We used a stereoscope that allowed us to present a gaze-contingent artificial scotoma in the two eyes separately. During the initial training, a visible scotoma of identical size (4° in diameter) was presented in each eye of five normally sighted subjects who were instructed to make saccades to search for a Tumbling-E stimulus that appeared randomly on the screen, and to identify its orientation. All subjects developed a “PRL” after 1500~5000 trials. Fixation stability improved and reached an asymptote over time. Immediately following the initial training, we doubled the size of the artificial scotoma in one eye (becoming 8°); and subjects performed the same task of identifying the orientation of the E-stimulus (letter size was enlarged). With visible scotomas, subjects were able to use the initially developed “PRL” to perform the task, with the fixation stability remaining at the initially reached asymptote. The trend was similar with invisible scotomas, despite a slight increase in fixation instability and “PRL” location variability. No difference was evident between the two eyes in either the “PRL” location or fixation stability. Our

results suggest that, rather than pushing the “PRL” outward in response to the increased scotoma size in one eye, subjects rely on the “PRL” in their better eye for visual tasks.

Acknowledgements: Grant support: NIH Grant R01-EY012810

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 11:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1341

Quantifying level of compensation after central vision loss

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Marcello Maniglia[1] (marcello.maniglia@gmail.com), Matthew Defenderfer[1], Leland Fleming[1], Pinar Demirayak[1], Dawn DeCarlo[2], Kristina Visscher[1]; [1]University of Alabama at Birmingham, Department of Neurobiology, [2]University of Alabama at Birmingham, Department of Ophthalmology

Retinal pathologies causing central vision loss, such as macular degeneration, are an increasingly common health problem, affecting elderly populations worldwide. Deprived of central vision, patients learn to use peripheral vision for daily tasks. Different patients compensate to different degrees: two patients with similar retinal damage or visual acuity score might exhibit very different performance in higher-level, cognitive tasks, indicating different levels of compensation. A first step toward understanding how people compensate for loss of central vision requires individual quantification of this compensation. This has historically been very difficult, since each person's retinal degeneration and compensation vary greatly. Few studies so far have tried to bridge the gap between anatomical examinations of the retina and cognitive evaluations. Here we propose a method for quantifying the level of compensation of patients suffering from central vision loss. This involves linear regression comparing a composite score of low-level visual assessments (contrast sensitivity, visual acuity and a novel eccentricity-weighted measure of visual sensitivity from microperimetry) to high-level cognitive measures that require vision (attention, emotion recognition, and visual function questionnaire). The regression line describes a profile of average compensation. Individual patient’s distances from the regression line are the estimated "compensation scores". In 22 MD participants, composite scores of low-level vision correlated significantly with composite scores of high-level tasks requiring vision, suggesting an overall strong relationship between low-level

vision and higher-level processes involving vision. Importantly, there were deviations from this relationship, indicating that some patients compensated more completely than others for impaired vision. We will discuss the benefit of including direct measures of retinal health along with behavioral measures. This approach paves the way for future work exploring the neural mechanisms of compensation for central vision loss, and these methods can be adapted to examine compensation in other modalities.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1641

Reward modulates visual perception independently of consciousness

Poster Presentation - *Topic area: Plasticity and Learning: Categories, models, disorders*

Mike Le Pelley[1] (m.lepelley@unsw.edu.au), Phillip Cheng[2]; [1]UNSW Sydney, [2]Macquarie University, Sydney

Reward plays a critical role in motivating overt, goal-directed behavior, and can also shape patterns of visual attention, with reward-related stimuli receiving automatic prioritization. In the current study, we demonstrate an ‘earlier’ effect of reward on visual perception, wherein the rewards signaled by visual stimuli modulate perceptual encoding and conscious experience of those stimuli. Our study used a visual masking procedure that required perceptual encoding, retention, and retrieval of a masked grating (memory cue). Experiment 1 showed that response accuracy was greater when a briefly presented (17 ms) and masked grating signaled that a high reward was available than when it signaled a low reward. Reward enhanced perceptual encoding/retention when participants reported awareness of the memory cue; notably, performance was also significantly above chance for high-reward (but not low-reward) gratings when participants reported being fully unaware of the memory cue. Experiment 2 demonstrated that this reward-driven enhancement was not a consequence of greater motivation to retrieve the memory cue on high-reward trials: when information about reward availability was provided at retrieval (rather than encoding), no advantage was observed for high-reward trials. These findings suggest that reward exerts an early and rapid influence to improve the fidelity of visual perception through strengthening information encoding and retention.

Acknowledgements: This research was funded by the Australian Research Council (DP170101715)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
22 June, 2:00 am EDT America/New_York

Presenter's Message

I hope you enjoy our poster and find it interesting! If you have any questions or would like a preprint of our manuscript describing this research, please contact me at m.lepelley@unsw.edu.au

Abstract ID: 204

Plasticity and Learning: Disorders

BOLD signal changes associated with orientation learning and transfer at different brain areas

Talk Presentation - *Topic area: Plasticity and Learning: Disorders*

Ding-zhi Hu[1] (dianahu@pku.edu.cn), Xin-yu Xie[1], Cong Yu[1], Peng Zhang[2]; [1]Psychology, McGovern Brain Research, and Center for Life Sciences, Peking University;, [2]Institute of Biophysics, Chinese Academy of Sciences

Perceptual learning research often targets learning specificities as means to understand the underlying mechanisms. However, learning specificities diminish with double training (Xiao_et_al_2008), and learning of basic visual features like orientation is not much location specific (Zhang_et_al_2010). Here we used fMRI to investigate the brain mechanisms underlying orientation learning and transfer. Twenty-three participants practiced orientation discrimination at the lower-left or -right quadrant at 135o or 45o. Five sessions of training improved orientation discrimination by 43.2±2.5% for the trained orientation at the trained quadrant, and 32.5±3.4% for the orthogonal orientation at the untrained quadrant, with 75% learning transfer. Subjects participated fMRI experiments before and after training. After training, BOLD responses in V1-V3 increased only for the trained stimulus. But BOLD responses in frontoparietal areas decreased for both trained and untrained stimulus, especially more for the untrained stimulus. Importantly, the amount of learning was negatively correlated with response changes to the trained stimulus in V1 and frontoparietal cortex, while the amount of learning transfer were positively correlated with a transfer index (trained-untrained) of BOLD response in V1, IFJ, IPS and PFC. Moreover, the task-based functional connectivity between frontoparietal cortex (IFJ/IPS/PFC) and V3 became weaker for the trained stimulus, but the connectivity between frontoparietal cortex and V2 became stronger for the untrained stimulus. The negative correlation between learning and BOLD signal change, and the decrease of functional connectivity between frontoparietal areas and early visual cortex for the trained stimulus, suggest that orientation learning may lead to a more efficient decision making in fronto-parietal areas. But the positive correlations

between the transfer index of BOLD changes and perceptual learning transfer, and the increased functional connectivity between frontoparietal areas and early visual cortex for the untrained stimulus, suggest that learning transfer may require more engagement of frontoparietal areas and their top-down modulation of early visual activities.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1749

Exogenous attention generalizes perceptual learning in adults with amblyopia

Talk Presentation - *Topic area: Plasticity and Learning: Disorders*

Mariel Roberts[1] (mariel.roberts@nyu.edu), Marisa Carrasco[1]; [1]New York University

[Goal] Amblyopia is a neurodevelopmental disorder characterized by visual disparities between the eyes. Perceptual learning (PL) protocols, in which observers perform the same task across several days, improve amblyopic vision to a limited degree. Exogenous attention remains functionally intact in adults with amblyopia. Attention generalizes PL to untrained locations in neurotypical adults. Here, for the first time, we manipulate observers' attention to investigate whether exogenous (involuntary) covert spatial attention facilitates and/or generalizes PL effects in adults with amblyopia. [Methods] Adults with amblyopia trained for 80 blocks (~10 sessions) on a 2-AFC orientation discrimination task using their amblyopic eye (dominant fellow eye patched). We monitored fixation with an eyetracker. We presented the Gabor stimuli at the contrast threshold (80% accuracy) of each eye for each observer. Observers were randomly assigned to train along one diagonal, either with peripheral attention cues (Attention group) or central cues (Neutral group). In sessions immediately before and after training, we measured training task performance for each eye along both diagonals. Observers were always presented with neutral attention cues during the contrast thresholding, pre-test, and post-test sessions. On the first and last days we also applied a test-battery to measure observers' foveal contrast sensitivity, acuity, crowding and stereoacuity. [Results] For both groups, training improved performance at the trained diagonal, but more so for the Attention group than the Neutral group. Remarkably, only in the Attention group, learning transferred to the untrained diagonal in both the amblyopic and high functioning fellow eye. Both groups improved performance in the battery tests. [Conclusions] Exogenous attention facilitates PL at trained spatial locations in the trained amblyopic eye. Moreover, it generalizes these performance improvements beyond the specific training conditions—to

the untrained spatial locations in the trained amblyopic and untrained fellow eyes. We discuss the translational implications of these findings for visual rehabilitation.

Acknowledgements: NIH NEI R01-EY019693

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1530

High-attention demand training enhances attentional modulation of V1 and intraparietal sulcus in human adults with amblyopia

Talk Presentation - *Topic area: Plasticity and Learning: Disorders*

Chuan Hou[1], Spero Nicholas[1]; [1]Smith-Kettlewell Eye Research Institute

The modulatory effects of selective visual attention on the input from the human amblyopic eye are substantially reduced in the primary visual cortex (V1) (Hou et al., 2016). Here, we provided electrophysiological evidence that training with high-attention demand tasks in adult amblyopes enhanced attentional modulation in V1 and intraparietal sulcus (IPS). We designed a dichoptic "feature counting" perceptual learning paradigm (Üner et al., 2017), which requires rapid searching and counting the vertical Gabors presented in the trained eye (90% of trials in the amblyopic eye, 10% in the fellow eye) while simultaneously being presented with distractors (horizontal Gabors) in the untrained eye. The training was about two visits per week and two hours per visit for two months. Before and after training, attentional modulation in V1 and IPS was measured using source-imaged SSVEP, and the stimuli were essentially identical to those used in Hou et al (2016). Two gratings (flickering at 12.5 and 16.67 Hz) were displayed with centers 7 deg to the left and right of a fixation point in the middle of the screen, and viewed monocularly with the non-viewing eye covered. A cue indicated that the observer should attend to left or right to detect a brief contrast increment on the cued grating. We compared the signal-to-noise ratio before and after training at the first harmonic of the driving frequencies. Our data show with the amblyopic eye, the modulation of the evoked response due to attention was enhanced in both V1 and IPS. In the fellow eye, modulation enhancement was observed in IPS, but not in V1. Visual acuity (VA) and counting performance (CP) were improved in both eyes with a higher percentage of improvement in the amblyopic

eye. However, neither VA nor CP improvement was correlated to enhanced attentional modulation in V1 and IPS.

Acknowledgements: This work was supported by NIH Grant R01- EY025018 awarded to Chuan Hou.

This talk will be presented in [Live Talk Session 4](), Monday, 22 June, 4:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 634

Less flexible perceptual learning of priors in adults with autism

Talk Presentation - *Topic area: Plasticity and Learning: Disorders*

Laurie-Anne Sapey-Triomphe[1,2] (laurieanne.sapeytriomphe@kuleuven.be), Laura Timmermans[1], Johan Wagemans[1,2]; [1]Laboratory of Experimental Psychology, Department of Brain and Cognition, Leuven Brain Institute, KU Leuven, 3000 Leuven, Belgium, [2]Leuven Autism Research (LAuRes), KU Leuven, 3000 Leuven, Belgium

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that remains poorly understood. Recent predictive coding theories suggest that atypical perceptual learning could play a central role in ASD. Here, we used two behavioral experiments to investigate prior learning and adjustment in ASD. In Experiment 1, 54 adults (31 neurotypical [NT] and 23 ASD) participated in a two-alternative forced-choice task where they had to compare the size of two discs. This task was designed to elicit a time-order effect, where perceptual decisions are biased toward the prior (i.e. mean disc size). The disc sizes followed either a narrow or broad distribution to elicit a strong or moderate prior bias, respectively. As expected, the NT group showed a stronger time-order effect in the narrow condition than in the broad condition. However, the ASD group did not show such difference between conditions, suggesting that ASD participants did not adapt the prior weight depending on the context. In Experiment 2, 51 adults (29 NT and 22 ASD) participated in an associative learning task. After hearing a high or low tone, they first had to predict whether they would see a clockwise or counterclockwise tilt, and then to report what they perceived. The cue and outcome were congruent in 62.5% of the trials and incongruent in 25% of the trials (unambiguous trials). In another 12.5% of the trials, there was no actual tilt (ambiguous trial). On average, both groups were able to predict the outcome above chance level, but contrary to NT, ASD participants did not adapt their predictions after a change in contingency. Finally, the two groups tended to perceive the ambiguous trials according to the

current contingency. Altogether, these results suggest that individuals with ASD can learn priors, but are less flexible than NT to adjust their priors according to the context.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 520

Spatial recalibration in cataract-treated individuals

Talk Presentation - *Topic area: Plasticity and Learning: Disorders*

Irene Senna[1] (irene.senna@uni-ulm.de), Sophia Pfister[1], Chiara Martolini[2], Monica Gori[2], Elena Cocchi[3], Marc O. Ernst[1]; [1]Dep. Appl. Cognitive Psychology, Faculty for Computer Science, Engineering, and Psychology, Ulm University, Germany, [2]Unit for Visually Impaired People (U-VIP), Italian Institute of Technology (IIT), Genova, Italy, [3]Istituto David Chiossone, Genova, Italy

Since vision typically provides more precise spatial information than other sensory modalities, early visual deprivation usually results in impaired spatial cognition and mobility. Here we tested Ethiopian children who suffered from congenital dense bilateral cataract and were surgically treated only years after birth. In Experiment 1, we assessed whether these individuals could spontaneously develop an appropriate representation of space once the cataract is removed. We tested patients' representation of the extrapersonal, peripersonal, and personal space. In particular we tested their ability 1) to localise visual and auditory stimuli, 2) to understand spatial relationships among sounds (by spatially bisecting three consecutive sounds), and 3) to point straight ahead along their mid-sagittal plane. After surgery, we observed enhanced spatial skills in all three tasks. Such improvement appeared mediated by time-since-surgery and post-surgical visual acuity. However, despite the improvement, cataract-treated children did not reach the level of sighted age-matched controls even few years after surgery. In Experiment 2, we investigated whether targeted audio-visuomotor training could boost such spontaneous recovery. Participants performed entertaining motor activities with the “Audio Bracelet for Blind Interaction” (ABBI), a device that associates audio-visual feedback to participants' body movements. Before and after the training, we retested participants with the same conditions from Experiment 1, and additionally in some tasks investigating their ability to navigate in the surrounding environment and to reach and grasp objects. After a short training (1-2 weeks), children dramatically improved in most tested spatial skills and in their mobility, even achieving the level of sighted controls in some tasks. The present findings show that, despite years of visual impairment, cataract-treated individuals can develop a more appropriate representation of

multisensory space after surgery. Such improvement can be considerably enhanced employing a targeted training strengthening the association between a movement and its sensory counterpart.

Acknowledgements: This work was supported by the Deutsche Forschungsgemeinschaft (DFG) DIP-Grant ER 542/3-1

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

VSS attendees with hearing loss are invited to contact me in private for video captions. You can contact me via chat or via email (irene.senna@uni-ulm.de).

Abstract ID: 1011

Plasticity and Learning: Models and mechanisms

Anisotropic representation of orientation by convolutional neural networks

Talk Presentation - *Topic area: Plasticity and Learning: Models and mechanisms*

Margaret Henderson[1] (maggiehende@gmail.com), John Serences[1,2,3]; [1]Neurosciences Graduate Program, UC San Diego, [2]Department of Psychology, UC San Diego, [3]Kavli Institute for Brain and Mind, UC San Diego

Visual representations learned by convolutional neural networks (CNNs) share some similarity in representational structure to neural representations in the primate ventral visual stream (e.g. Yamins et al., 2014). However, the organization of low-level feature representations by CNNs has not been extensively characterized. Understanding whether CNNs develop idiosyncrasies that mimic the properties of the primate visual system is important for developing models that can inform our understanding of the brain. Additionally, because many aspects of CNN representations are acquired through training, examining feature representations of CNNs is a useful tool for determining which properties of the primate brain might be innate and which are likely to be acquired through experience. Here, we focus on orientation perception, a well-understood aspect of the primate visual system. We asked whether convolutional neural networks trained to perform object recognition on a natural image database would exhibit an “oblique effect” such that cardinal (vertical and horizontal) orientations are represented with higher precision than oblique (diagonal) orientations, as has been measured in the brain and behavior of primates. We obtained

activation patterns from a pre-trained VGG-16 network (Simonyan & Zisserman, 2014) presented with oriented grating stimuli, and used a Euclidean distance metric to measure the discriminability between patterns corresponding to different pairs of orientations. In agreement with human perception, we find that orientation discriminability generally peaked around the cardinal orientations. This effect emerged at middle layers of the VGG-16 network. Its magnitude increased with stimulus spatial frequency, but decreased with stimulus uncertainty. We also trained networks from scratch using images from the ImageNet database (Deng et al., 2009) that had been rotated by varying increments. Overall, our findings suggest that cardinality effects in human visual perception are not dependent on a hard-wired anatomical bias, but can instead emerge through experience with the statistics of natural images.

Acknowledgements: Funding provided by NEI R01-EY025872 to J.T.S. and a UCSD Institute for Neural Computation predoctoral fellowship awarded to M.M.H.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
22 June, 11:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

For more information, please feel free to email me (maggiehende@gmail.com) or follow me on Twitter (@maggiehende)

Abstract ID: 224

Attention to different statistical structures changes over the course of learning

Talk Presentation - *Topic area: Plasticity and Learning: Models and mechanisms*

Tess Allegra Forest[1] (taforest@gmail.com), Noam Siegelman[2], Amy Finn[1]; [1]University of Toronto, [2]Haskins Laboratories

Previous studies have shown that attention allocation can be determined by the statistical structure of our visual environments: infants attend to moderately predictable input over highly predictable or highly unpredictable input (Kidd et. al., 2012), and adults attend to regular over irregular stimuli (Zhao et. al., 2013). While these results show learners are sensitive to how predictable different input is, no study to date has directly examined how attention to differently structured input shifts as a function of experience. Moreover, learners may be able to extract more or less information from a particular part of their world at

any given moment, but it remains unknown whether we flexibly shift attention based on how much information could be gained from a particular stimulus. Here, we had adults (n=75) complete a visual statistical learning experiment in which streams of information were presented simultaneously in four locations, in four levels of predictability: (1) completely random, (2) low predictability, (3) medium predictability, and (4) completely predictable. Intermittent search trials measured where participants attended over the course of the experiment by indexing reaction times in each location. We modeled trial-by-trial entropy in each location to measure how much information could be gained from that location at any given point during learning. Our results show that as the experiment progressed, participants shifted from attending to medium predictability location to attending to lower levels of regularity locations (low predictability and random stream). Additionally, trial-by-trial entropy and time interacted strongly to predict where participants attended, such that over the course of learning higher entropy locations were attended more. This provides the first demonstration that as adults learn the environmental regularities, they gradually shift their attention to less predictable sources of information, and that learners are sensitive to how much information they can gain from a particular source.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 293

Creating Visual Categories With Closed-Loop Real-Time fMRI Neurofeedback

Talk Presentation - *Topic area: Plasticity and Learning: Models and mechanisms*

Marius Cătălin Iordan[1] (mci@princeton.edu), Victoria J.H. Ritvo[1], Kenneth A. Norman[1], Nicholas B. Turk-Browne[1,2], Jonathan D. Cohen[1]; [1]Princeton University, [2]Yale University

Information about visual categories is widely available across the brain (Huth et al. 2012) and these representations can be modulated by learning and training (Clarke et al. 2016). However, the causal link between neural representations of categories and their perception has not been established in humans. To address this question, we sought to change neural representations via closed-loop real-time fMRI neurofeedback (deBettencourt et al. 2015) and test whether this drives categorical perception. We hypothesized that increasing neural separation between categories should also differentiate the categories

perceptually. To test our hypothesis, we constructed a stimulus space of complex artificial shapes that varied along multiple dimensions simultaneously (Kok et al. 2018) and we conducted a multi-session closed-loop real-time fMRI study (n=10) in which we sought to induce plasticity in neural representations elicited by arbitrary novel visual categories from the stimulus space. Our neurofeedback procedure nudged neural representations in visual, parahippocampal, and frontal cortex of our participants, resulting in significant increases in neural separation (category log-likelihood ratio for a multivariate Gaussian decoding model) for the trained categories compared to the untrained categories. Furthermore, for each participant, the amount of increase in neural separation significantly predicted the increase in perceptual categorization ability after training, compared to before training (higher psychometric function sharpening for trained vs. untrained categories in a behavioral 2AFC task). Our results suggest considerable plasticity in the structure of cortical representations evoked by visual stimuli and begin to establish the causal role for this plasticity in human behavior. Beyond implicit category learning, this technique also opens the door to a new paradigm of fMRI research that tests causal links between neural representations in various brain regions and different behaviors. This partly overcomes the typical correlational limitations of non-invasive methods for studying the human brain, creating the possibility of targeted causal interventions.

Acknowledgements: John Templeton Foundation, Intel Corporation, NIH R01 MH069456

This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for stopping by! For any questions or comments, please come to one of the live sessions, type in chat, or email me at: mci@princeton.edu. Also, be on the lookout for our preprint, coming out this summer!

Abstract ID: 422

Reward refreshes memory: the retroactive effect on incidental statistical learning

Talk Presentation - *Topic area: Plasticity and Learning: Models and mechanisms*

SU HYOUN PARK[1] (suhyounpark@gmail.com), LEELAND L. ROGERS[1], TIMOTHY J. VICKERY[1]; [1]University of Delaware

Reward motivation enhances memory formation (Adcock et al., 2006). Here we examine the retroactive effect of reward on memory formation occurring during visual statistical learning, a type of incidental learning. In a learning phase, participants were required to passively view a sequence of images. Unbeknownst to participants, the thirty-two images were statistically structured as eight quadruplets, and quadruplets were equally divided into two types of sequences --rewarded sequences (e.g., ABCD) and non-rewarded sequences (e.g., A'B'C'D'). Subsequently, in the value-learning phase, participants were told there were quadruplets in the previous phase, and half of the quadruplets were rewarded sequences, while the other half were non-rewarded sequences. During this phase, the last items of quadruplets (e.g., D and D') were shown, and participants had a chance to learn whether those last items belong to a rewarded sequence or a non-rewarded sequence. Following these two learning phases, two memory tests were performed. In the sequence recognition test, two sequences (one target and one foil) were presented, and participants had to choose which was more familiar. Critically, target and foil sequences consisted of only the first three items of quadruplet (e.g., target: ABC or A'B'C'; foil: AFK or A'F'K'). We excluded the last item to ask whether the learned reward association retroactively refreshed memory for other members of a sequence. We found that recognition rate of rewarded sequences was significantly higher than non-rewarded sequences, despite the absence of the image learned during value-learning and despite the absence of reward during the passive viewing phase. In a final reward memory phase, participants showed above chance ability to identify reward vs. non-reward images. Our results are the first to show that memory associations can be enhanced by being refreshed with novel reward information, even when memory was indirectly associated with reward.

Acknowledgements: NSF BCS 1558535; NSF OIA 1632849

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for your interest in my talk! My slides with notes are available by request. Please email me at suhyounp@udel.edu. Thanks!

Abstract ID: 1349

The functional forms of perceptual improvement: A multi-paradigm comparison of by-trial, subject-level models

Talk Presentation - *Topic area: Plasticity and Learning: Models and mechanisms*

Aaron Cochrane[1] (akcochrane@wisc.edu), C. Shawn Green[1]; [1]University of Wisconsin -- Madison

The mathematical functions underlying learning have implications for the empirical understanding of learning phenomena as well as the underlying processes of change giving rise to learning. Most previous studies examining the functional form of learning have aggregated data across learners, learning events [trials], or both, thereby reducing the precision of parameter estimates and possibly biasing both parameters and estimates of error. Recently visual perceptual learning has been used as a model domain to demonstrate some such detrimental implications of aggregation. However, by-trial subject-level analyses have yet to be used systematically to compare specific learning functions. Here we report two perceptual learning experiments in which participants completed at least 1200 trials of training, followed by at least 400 trials of generalization, on either an oriented-line oddball-texture-detection task (n= 32) or a dot-motion delayed nonmatch-to-sample task (n=40). Tests of generalization allowed for a unified analysis of the functional form of initial learning as well as generalization thereof. We fit five nonlinear learning functions to participant- and trial-level data to determine the functional form of learning most appropriate. Learning functions were fit from two families: exponential (3-parameter exponential, 4-parameter “double” exponential, and 4-parameter Weibull) and power (3-parameter power and 4-parameter power). Information criteria were calculated for each functional form and these were compared to determine the relative evidence supporting each function. Texture-detection learning was best fit by the three-parameter exponential function in 29 participants; the remaining 3 participants were best fit by either the three-parameter power function or the Weibull function. Dot-motion learning was best fit by the 4-parameter Weibull function (30 participants) or the 3-parameter exponential function (10 participants). These results collectively repudiate the “power law of learning” while implicating, respectively, single (in texture detection) and dual (in motion discrimination) mechanisms of change during visual perceptual learning.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

researchgate.net/profile/Aaron_Cochrane
github.com/akcochrane/TEfits

Abstract ID: 1203

Plasticity and Learning: Perceptual learning

Alertness-induced transfer of visual perceptual learning to untrained orientations and eye, which is induced by neither reward nor attention

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Zhiyan Wang[1] (zhiyan_wang@brown.edu), Dongho Kim[2], Giorgia Pedroncelli[1], Yuka Sasaki[1], Takeo Watanabe[1]; [1]Brown University, [2]Sungkyunkwan University, Suwon, Korea

Despite the enduring interest in alertness, no research has been conducted to clarify its relationship with visual perceptual learning (VPL, Watanabe & Sasaki, 2015). To examine the relationship, we varied the temporal order of an exposed visual stimulus and the alertness cue. During 12-daily training sessions, two orientations were presented in the trained eye in a random order, whereas simultaneously high contrast dynamic color patches were presented to the untrained eye to render the stimulus imperceptible (Tsuchiya & Koch, 2005; Seitz, Kim & Watanabe, 2009). A beep sound was presented 400 ms prior (Pre-Cue group, n=10) or subsequent to (Post-Cue group, n=6) the presentation of one of the orientations (paired orientation), whereas the other orientation was not paired with sound (unpaired orientation). Subjects were tested on the two orientations in each eye in pre- and post-tests. In both groups, significant VPL of the paired orientation was observed in both the trained and untrained eyes. Unexpectedly, VPL transferred to the unpaired orientation in the Post-Cue group. Attention should not play a role in inducing the transfer to the unpaired orientation, as it is pre-cues that are more efficient in association with attention (Liu et al., 2005). Previously, we presented reward instead of a sound in an otherwise identical paradigm to the current study (Wang, Kim, Sasaki and Watanabe, 2018). VPL occurred only in the paired orientation, in the trained eye of the Post-Reward group, suggesting that VPL driven by reward is significantly different from VPL by alertness. Our results are in accordance with the hypothesis that alertness impacts on the activity in the locus coeruleus norepinephrine (LC-NE) system which influences the decision-making areas (Aston-Jones & Cohen, 2005), where orientations are less specifically processed, which allows for transfer of VPL to other orientations.

Acknowledgements: T32MH115895, BSF2016058, R21EY028329, R01EY027841, R01EY019466

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 704

Evaluating the functional form of perceptual learning with trial-by-trial analysis

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Yukai Zhao[1] (zhaoyukai@alumni.usc.edu), Pan Zhang[1], Ge Chen[2,3,4], Jia Yang[2,3], Chang-Bing Huang[2,3], Jiajuan Liu[5], Barbara Anne Dosher[5], Zhong-Lin Lu[1,6]; [1]Center for Neural Science, New York University, New York, USA, [2]CAS Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, Beijing, China, [3]Department of Psychology, University of Chinese Academy of Sciences, Chinese Academy of Sciences, Beijing, China, [4]School of Arts and Design, Zhengzhou University of Light Industry, Zhengzhou, Henan, China, [5]Department of Cognitive Sciences and Institute of Mathematical Behavioral Sciences, University of California, Irvine, CA, USA, [6]Division of Arts and Sciences, NYU Shanghai, Shanghai, China

The functional form of the learning curve is one of the fundamental characterizations of perceptual learning. Dosher & Lu (2007) compared a number of functional forms for their ability to fit learning curves (reduced contrast thresholds in an orientation identification task) estimated from blocks of trials with a staircase procedure, and concluded that a single exponential function fit best. Recently, we showed that learning curves estimated from blocks of trials in staircase procedures are imprecise and may be biased, especially in fast learning situations (Zhang et al, 2019). A more detailed evaluation of the functional form of perceptual learning with trial-by-trial data is necessary. In this study, we developed a generative model in which the threshold in each trial is determined by the learning curve generated with a candidate functional form, the probability of a correct response reflects the trial-specific psychometric function, with the predicted response drawn from the Bernoulli distribution. The quality of fit was computed as the sum of the loglikelihood across the entire learning curve. Five candidate models (exponential, power, Apex, summed exponentials, cascade exponentials) were fit to the published experimental data from three perceptual learning tasks: contrast detection (n=41; Zhang et al., 2018), Vernier offset discrimination (n=16; Zhang et al., 2018), and orientation identification (n=78; Liu, Dosher and Lu, 2010, 2012), using the Bayesian information criterion (BIC, Schwarz, 1978) for model selection. We found the preferences in pairwise comparisons are: (1) exponential 65.93%, power 5.19%, no preference 28.89%; (2) exponential 96.30%, Apex 3.70%; (3) exponential 98.52%, summed exponentials 1.48%; and (4) exponential 83.70%, cascade exponentials 14.81%, no preference 1.48%. In most cases, a single exponential function provided the best account of the learning curve in perceptual learning, implying a constant relative rate of learning.

Acknowledgements: National Eye Institute (EY021553 and EY017491)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1643

Generality of learning as driven by dichoptic visual training

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Ka Yee KAM[1] (kkykamky@connect.hku.hk), Ailene Y. C. Chan[1], Dorita H. F. Chang[1]; [1]The University of Hong Kong

Training protocols involving dichoptic presentation of motion stimuli have been shown to be effective in promoting eye rebalancing and improving binocular functions; however, the mechanisms underlying these improvements have yet to be clarified. Here, we aimed to characterise mechanisms underlying learning-induced improvements in sensory eye balance and binocular functions by testing the generality of learning effects that can be attained with different training and test cues. Two groups of visually-normal observers were trained on one of two tasks: a dichoptic signal-noise motion task or a dichoptic fine motion task. In the signal-noise task, signal dots carrying a coherent motion direction and randomly-moving noise dots were presented dichoptically. The observers' task was to indicate the net motion direction of the stimulus. In the fine task, stimuli carried a center-surround configuration such that a reference motion direction in the surround was presented to one eye while a target direction in the center was presented to the alternate eye. The observers' task was to judge whether the motion direction carried by the central target was offset clockwise or counter-clockwise with respect to the reference motion. Observers received training over three consecutive days (3600 trials) and were tested on a binocular phase combination task to index sensory eye balance, signal-noise and fine depth discrimination tasks to measure stereopsis, and dichoptic signal-noise and fine tasks involving both motion and orientation cues before and after training. Results showed that both training tasks altered sensory eye dominance and improved stereopsis. Interestingly, training on both tasks generalized to improvements in the orientation task, but training using the signal-noise manipulation drove a broader transfer of learning. Our data suggest that in addition to the dichoptic presentation mode itself, the nature of the training stimulus may also exert influence on training effectiveness, potentially implicating signal-noise segregation mechanisms in dorsal cortex.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 642

High-attention demand training improves contrast sensitivity in adults with amblyopia

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Gabriela Acevedo Munares[1], Xin Jie Lai[1], Ismet Joan Üner[1], Chuan Hou[1]; [1]Smith-Kettlewell Eye Research Institute

Amblyopia, predominated by reduced visual acuity, loss of contrast sensitivity and depth perception, occurs when the brain favors one eye over the other. The non-preferred (amblyopic) eye is suppressed to allow for better visual interpretation of the surroundings. It is suggested that selective visual attention is involved in amblyopic suppression mechanisms (Hou et al., 2016). In this study, we hypothesize that training adult amblyopes with high-attention demand tasks improves their contrast sensitivity. To test this, we compared two training programs in adult amblyopes using a dichoptic approach: a high-attention task group compared to a low-attention task group. The high-attention task consisted of quickly searching and counting the vertical Gabors presented in the amblyopic eye while simultaneously being presented with distractors (horizontal Gabors) in the non-amblyopic eye. It is well known that searching and counting features require rapid shifts in attention and are considered high-attention demand tasks (Egeth et al., 2008; Anobile et al., 2012). The low-attention task was to report a simple horizontal and/or vertical rectangle that was presented to each eye, which needs little attentional effort. The two groups of amblyopes were randomly assigned into the two training programs. Both programs were about two visits per week and two hours per visit for two months. Contrast sensitivity was measured before and after training. Our training results show that for the majority of amblyopes in both groups, the contrast thresholds were decreased after their corresponding training, suggesting contrast sensitivity improvement from both training programs. However, the average contrast sensitivity improvement percentage was twice as large in the high-attention training group than it was in the low-attention training group. Our results support the view that training with high-attention demand tasks may provide important insight for treating amblyopia and perhaps other cortical dysfunctions.

Acknowledgements: This work was supported by NIH Grant R01- EY025018 awarded to Chuan Hou.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 852

Hypothesis testing of the parameters of the learning curve based on hierarchical Bayesian

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

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Hypothesis testing about parameters of fitted models has been challenged by potential covariance between them. Here, we adopted the hierarchical Bayesian (HB) framework to model the parameter covariance in learning curves in perceptual learning, and test hypotheses about individual parameters for different conditions. Specifically, we analyzed data from Zhang et al (2018), who studied the effects of monetary reward on perceptual learning, comparing high, subliminal, block, low, or no reward. In that study, a two-parameter power function (initial threshold and learning rate) was fit to the learning curve of each observer. However, the covariance between parameters for initial thresholds and learning rates made it difficult to compare them across conditions. In this study, we constructed a hierarchical Bayesian model, in which five joint hyperparameter distributions of initial threshold and learning rate, one for each reward condition, were specified. The parameters of individual observers in each reward condition are drawn the corresponding hyper-distribution(s). The maximum likelihood was used to compute the distributions of the hyper parameters and parameters of each observer. We found that initial threshold and learning rate were positively correlated (ranging from 0.116 to 0.570). After controlling the covariance, ANOVA revealed that the initial thresholds and learning rates were both significantly different across the five reward conditions (all p=0). Post hoc multiple comparison found that the initial threshold was comparable among the high, no and low reward conditions, and between the no and block reward conditions. However, the learning rate was significantly different (α= 0.05) between all pairs except between the high and subliminal reward conditions. The method developed in this study can be generalized to conduct hypothesis testing about parameters of fitted models.

Acknowledgements: Supported by the National Eye Institute (EY021553 and EY017491).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1637

Impact of aging, perceptual learning and attention on driving performance

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

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The incidence of automotive crashes is particularly high among drivers under the age of 25 (Evans, 2004; Williams & Carsten, 1989) and over the age of 65 (Tefft, 2008; Evans, 2004). An important issue for driving safety is identifying potential ways to reduce crash risk by examining drivers' ability to detect impending collisions. Perceptual learning (PL)---improvements on a perceptual task as a result of repeated exposure---has been shown to improve collision detection in both older and younger adults (Deloss, Bian, Watanabe & Andersen, 2015; Lemon, Deloss & Andersen, 2017). An important component of PL training is attention, which has been found to improve perceptual performance for a variety of perceptual tasks (see Byers & Serences, 2012). The present study investigated the effect of attention and PL on collision detection for both older and younger drivers in a dual-task driving paradigm. Drivers were presented with a computer-simulated roadway scene and maintained within-lane vehicle steering while also identifying which object among a number of objects (number of objects; 2,4,8) will collide with the driver. During training, drivers were trained over several days with a number of objects (2,4,8). Drivers were either presented with an endogenous cue (identifying the visual field location of the collision object) or a neutral cue. The results indicated overall decreased detection performance (lower accuracy and greater RT) with an increase in the number of objects. PL resulted in improved collision detection performance for both older and younger drivers. In addition, greater accuracy and RT were found when an endogenous attention cue was present with improved performance for both younger and older drivers. These results indicate the benefits of training and attention in collision detection.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 452

Improving the precision of the estimated learning curve in perceptual learning by rescoring the trial-by-trial staircase data with the qCD algorithm

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Pan Zhang[1] (zhang2005pan@126.com), Yukai Zhao[1], Barbara Dosher[2], Zhong-Lin Lu[1,3]; [1]Center for Neural Science, New York University, New York, United States, [2]Department of Cognitive Sciences and Institute of Mathematical Behavioral Sciences, University of California, Irvine, United States, [3]Division of Arts and Sciences, NYU Shanghai, Shanghai, China

The staircase procedure is used to estimate the learning curve through measurements of thresholds in blocks of trials in most perceptual learning studies. Recently, researchers developed the quick Change Detection (qCD) method to measure the trial-by-trial time course of dark adaptation (Zhao, et al, 2017, 2019) and perceptual learning (Zhang et al, 2019). The qCD method provided more precise and accurate estimates of the learning curve than the standard staircase method. The question is whether rescoring the trial-by-trial staircase data improves the precision of the estimated learning curves. Rescoring simulated staircase data using the qCD algorithm indeed resulted in much-improved accuracy and precision of the estimated learning curves. Here we rescored the experimental data from Zhang et al (2019). In that study, each of the five observers was trained in a 4 alternative forced-choice global motion direction identification task, with the coherence level in the odd trials controlled by the qCD method and that in the even trials controlled by a 3-down/1-up staircase procedure. We rescored the trial-by-trial staircase data using the trial-by-trial and post hoc segment-by-segment qCD algorithms. We also estimated the 68.2% credible interval (HWCI) of the estimated block thresholds from the staircase method with a bootstrap method. We found that, averaged across the entire learning curve and observers, the 68.2% HWCI of the rescored coherence threshold was 0.025±0.002 (mean±sd) and 0.014±0.002 in trial-by-trial and segment-by-segment analysis, respectively. In comparison, the average 68.2% HWCI of the estimated threshold from the staircase method was 0.055±0.001, and the average 68.2% HWCI of the estimated threshold from the qCD method was 0.022±0.001 and 0.012±0.001 in trial-by-trial and segment-by-segment analysis, respectively. We conclude that rescoring the trial-by-trial staircase data in perceptual learning with the qCD algorithm could greatly improve the precision of the estimated learning curve.

Acknowledgements: National Eye Institute (EY021553 and EY 017491)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1227

Interactions of reward and sleep can be harmful to presleep visual perceptual learning by rendering the learning more vulnerable to interference or catastrophic forgetting

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Takashi Yamada[1] (takashi_yamada@brown.edu), Masako Tamaki[1], Zhiyan Wang[1], Takeo Watanabe[1], Yuka Sasaki[1]; [1]Department of Cognitive, Linguistic and Psychological Sciences, Brown University

An accumulating body of evidence has suggested that each of sleep and reward is beneficial to visual perceptual learning (VPL). First, we found that sleep not only enhances performance of presleep VPL but also stabilizes presleep VPL to be resilient to retrograde interference by postsleep learning (Sasaki and Watanabe, 2019). Second, we found that reward interacts with post-training sleep to enhance visual plasticity and leads to a greater performance gains of presleep VPL (Berard et al 2015), suggesting that interactions of reward and sleep are generally beneficial for presleep VPL. If so, interactions of reward and sleep should reduce "catastrophic forgetting", that is, the retrograde interference by postsleep learning with presleep learning. To test the hypothesis, we trained participants on two blocks of a texture discrimination task (TDT) whose background orientations were orthogonal to each other with a 100-min nap between these two blocks. When the two blocks of the TDT with orthogonal background orientations were trained sequentially, learning of the first and second TDTs interfere with each other (Yotsumoto et al, 2009), unless the first learning of TDT was stabilized by sleep (Tamaki et al, 2019). In the reward condition, participants were water-deprived for 5 hours before the experiment and given water drops as a reward for each correct response during the first training before sleep. In the no-reward condition, participants were neither water-deprived nor given water during training. No reward was provided during the second training after sleep in either condition. Contrary to our prediction, retrograde interference was observed in the reward condition, but not in the no-reward condition. These results indicate that interactions of reward and sleep are not always beneficial to presleep learning. Perhaps reward interacts with sleep to enhance visual plasticity, which renders presleep VPL so plastic as to be vulnerable to retrograde interference.

Acknowledgements: R21EY028329, R01EY027841, R01EY019466, BSF2016058, T32MH115895

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1183

Perceptual learning of orientation identification in filtered external noise: a test of the integrated reweighting theory (IRT)

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Barbara Dosher[1] (bdosher@uci.edu), Jiajuan Liu[1], Zhong-Lin Lu[2]; [1]University of California Irvine, [2]NYU Shanghai and NYU

Perceptual templates for identifying stimuli varying in one dimension may also be tuned along other stimulus dimensions. We examine perceptual learning of orientation judgments in the presence of low- and high-pass filtered external noise to estimate the spatial-frequency sensitivity of the perceptual template. External noise in spatial frequencies overlapping with the template causes elevated thresholds. In this study, we use the integrated reweighting theory (IRT, Dosher et al., 2013), elaborated for multi-alternative choice, to account for the spatial frequency sensitivity of perceptual judgements and learning in a 4-alternative identification (-67.5°, -22.5° +22.5°, or +67.5° from vertical) task for Gabors displayed with filtered external noise. Contrast thresholds (3/1 and 2/1 staircases, averaged for 75% correct) were measured in five low-pass and five high-pass filtered external noise conditions. Observers participated in 14 training sessions with Gabor stimuli (2.66 cpd, sigma = 0.42°) in one of two precued locations at opposite diagonals in periphery, then 2 sessions in locations on the other diagonal, and 2 sessions with Gabors in a new spatial frequency (0.67 cpd, sigma = 0.42°). Threshold vs cutoff spatial frequency functions in the low- and high-pass conditions crossed over near the center frequency of the Gabor, indicating the tuning of the decision template; perceptual learning showed reduced thresholds in both the low and high noise limbs of the functions; switched locations showed partial transfer, and the cross over point shifted towards the center frequency of the new Gabors after the switch. Here we show that the 4-AFC IRT model predicted the observed sensitivity to masking and the improvements in contrast thresholds during learning, and performance in the transfer tests (despite some quantitative departures for transfer to the new spatial frequency). The decision weights of activations in different spatial-frequency and orientation-tuned representation units revealed the “template” used in the task.

Acknowledgements: Supported by National Eye Institute Grant # EY–17491.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 904

Similar perceptual learning in 10-alternative letter identification in external noise with and without feedback supervision

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Jiajuan Liu[1], Zhong-lin Lu[2], Barbara Dosher[1]; [1]University of California, Irvine, [2]NYU Shanghai and NYU

Perceptual learning in n-alternative identification (nAFC) has been found with accuracy feedback (correct or incorrect) for faces, filtered texture patterns (Gold et al. 1999), and peripheral letter identification in reduced vision (Chung et al., 2005). Here we examined learning without feedback and with response feedback (providing the correct response) in a 10AFC letter identification task, and compared the results with those of prior studies which showed (a) faster learning with response feedback but small amounts of learning without feedback (especially compared to the often robust unsupervised learning in 2AFC tasks) in 8AFC orientation identification (Liu et al, VSS 2018), and (b) both results can be successfully modeled via reweighting (improved readout) from a hierarchy of sensory representations in an n-AFC integrated reweighting theory (IRT) (Dosher et al. 2013). In the current study, observers were trained either without feedback or with response feedback to identify spatial-frequency filtered letters (CDHKNORSVZ) (Hou et al., 2015), temporally embedded (NSN at 60 Hz) in white external noise (sigma=0.33), with letter contrasts of 0.25, 0.5, or 1.0 intermixed randomly over trials. Observers practiced in five 1200-trial sessions and then one session without external noise and with feedback (for internal noise estimation). Learning was robust in both response feedback and no feedback conditions, and the rate of learning was only slightly faster for response feedback. These results contrasted noticeably with those for 8-alternative identification of unidimensional orientation, where response feedback yielded much faster learning rates, and learning without feedback was very modest (Liu et al, VSS 2018). IRT model simulations indicated that this reduced sensitivity to full feedback supervision likely reflects the multidimensional similarity structure of the letters (seen in multi-dimensional scaling of letter confusion data) and the role of pre-existing letter templates in learning to identify the letters in external noise.

Acknowledgements: Supported by the National Eye Institute Grant # EY–17491.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1237

The role of external feedback and internal reward in Perceptual learning of 4AFC orientation discrimination task

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Jia Yang[1,2] (yangj@psych.ac.cn), Fangfang Yan[1,2], Changbing Huang[1,2]; [1]CAS Key Laboratory of Behavioral Science, Institute of Psychology, Chinese Academy of Sciences, Beijing, China,, [2]Department of Psychology, University of Chinese Academy of Sciences, Chinese Academy of Sciences, Beijing, China,

Both external feedback (e.g. auditory) and internal reward signal (e.g. introduction of an easy task) can facilitate perceptual learning, providing evidence for supervised and Hebbian learning rules in PL. Characteristics of these two learning mechanisms remained unanswered. In the current study, we trained six groups of subjects to learn a 4-Alternative forced-choice (4-AFC) grating orientation discrimination task that differed in types of feedback (no, auditory, and full feedback) and performance accuracy (two staircases converge to 35% correct, one staircase converges to 35% and the other 70%) to examine the learning benefits from feedback and high accuracy. While auditory feedback just indicated the correctness of each response, full feedback included a tone to indicate correct response and a re-displayed grating of correct orientation, which provided complete information. The results showed that: 1) Thresholds decreased for all 6 groups as training proceeded; 2) External feedback prompt learning gradually with information carried by feedback increased; 3) Adding easy task (i.e. 70% correct) improved performance significantly, showing the benefit of internal reward; 4) Interaction of external feedback and internal reward was observed in some but not all conditions, manifesting the flexibility of system employment of different information to optimize perceptual performance. A potential hybrid model will also be discussed.

Acknowledgements: This work was supported by the National Natural Science Foundation of China grant (NSFC 31470983 and 31400877 to CBH) and Chinese Post-doctoral Research Foundation (2018M641514 to FFY)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1651

Visual perceptual learning (VPL) of background natural scenes works in a different manner than that of artificial images—the first step for systematic investigations of VPL of natural scenes

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Kazuhisa Shibata[1] (kazuhisa.shibata@riken.jp), Daiki Ogawa[2], Yuka Sasaki[3], Takeo Watanabe[3]; [1]RIKEN Center for Brain Science, [2]Nagoya University, [3]Brown University

Visual perceptual learning (VPL) refers to long-term performance improvement as a result of visual experience (Sagi, 2011; Watanabe & Sasaki, 2015). In almost all VPL studies, artificial stimuli (AS) have been used. Whether VPL of natural scenes (NS) and/or everyday visual environment follows the same rules as

VPL of AS has never been systematically investigated. A series of studies have found that task-irrelevant VPL of supra-threshold AS does not occur because attentional systems detect and suppress the supra-threshold task-irrelevant feature signals (Tsushima et al, 2006, 2008; Chang et al, 2014). Here, we tested whether task-irrelevant VPL occurs with supra-threshold NS. There were 2 conditions, NS and AS conditions (N=8 each). During a 10-day exposure stage, participants in the NS condition were repeatedly exposed to a set of supra-threshold task-irrelevant NS in which a particular orientation (trained orientation) was dominant. In the AS condition, participants were exposed to supra-threshold task-irrelevant AS that consisted of the identical mean luminance, orientation and spatial frequency distributions to those of the NS. The participants were asked to conduct a difficult rapid serial visual presentation (RSVP) task throughout the exposure stage. Before and after the exposure stage, participants' performance on a discrimination task was measured on both the trained orientation and untrained orientation (90 deg rotated from the trained) using a Gabor patch. We found a significant performance improvement for the trained orientation, but not for the untrained orientation, after the exposure stage in the NS condition. In contrast, no significant performance improvement was observed for either orientation in the AS condition. These results indicate that the mechanisms of VPL of NS in everyday life may not be the same as VPL of AS. If so, the framework of VPL based on these 30 years of research would have to be greatly modified.

Acknowledgements: This work is supported by JSPS KAKENHI Grant Number 19H01041 (to KS), NIH R01EY027841, R01EY019466 (to TW), R21EY028329 (to YS) and United States - Israel Binational Science Foundation BSF2016058 (to TW).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 942

We don't all look the same; detailed examination of peripheral looking strategies after simulated central vision loss

Poster Presentation - *Topic area: Plasticity and Learning: Perceptual learning*

Aaron Seitz[1] (aseitz@ucr.edu), Marcello Maniglia, Kristina Visscher; [1]University of California, Riverside, [2]University of Alabama, Birmingham

Loss of central vision can be compensated by increased use of peripheral vision, for example patients with macular degeneration, or those experiencing simulated central vision loss, develop eccentric viewing

strategies for reading or other visual tasks. In both patients and in simulated conditions there are substantial individual variations in effective use of periphery after central vision loss. Factors driving these individual differences are still unclear, and the field has not yet well-characterized these complex eye movement patterns. We recently proposed a systematic approach to characterize eye movement strategies in cases of central vision loss that distinguishes different oculomotor components, describing 6 aspects of eye movements that may change as eye movement patterns are learned: First Saccade Landing Dispersion, Saccadic Re-referencing, Saccadic Precision, Percentage of Trials that are Useful, Fixation Stability, and Latency of Target Acquisition (Maniglia, Visscher, Seitz, ECVP 2019). Here we use this approach to characterize the time-course of changes in oculomotor strategies through training in 19 healthy individuals with a gaze contingent display obstructing the central 10° of the visual field. We found improvements in re-referencing (the percentage of trials in which the first saccade placed the target outside the scotoma), and latency to target acquisition (time interval between target presentation and a saccade that would put the target outside the scotoma) over 10 days of training. This result is consistent with participants improving oculomotor strategies as a result of training. Notably, there were strong individual differences in these metrics. Here we present both the summary statistics as well as a characterization of different patterns of changes in these eye metrics, both within and across participants, and how these related to task-performance. This more complete characterization of peripheral looking strategies and how they change with training can help us understand individual differences in rehabilitation after central vision loss.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The correct link is:

https://ucr.zoom.us/j/98851853743

Abstract ID: 1794

Plasticity and Learning: Statistical learning, applications

“Learning to learn” as a new path for learning generalization in working memory: the case of action video game play

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Ru-Yuan Zhang[1,2] (ruyuanzhang@gmail.com), Adrien Chopin[3,8], Kengo Shibata[3], Zhong-Lin Lu[4], Susanne M. Jaeggi[5], Martin Buschkuehl[6], C.Shawn Green[7], Daphne Bavelier[1,3]; [1]Department of Brain and Cognitive Sciences and Center for Visual Sciences, University of Rochester, Rochester NY 14628, [2]Center for Magnetic Resonance Research, Department of Neuroscience, University of Minnesota, Minneapolis, MN 55455, [3]Faculté de Psychologie et Science de l'Education, University of Geneva, Geneva, Switzerland, [4]NYU Shanghai and Center for Neural Science, New York University, NY. 10003, [5]School of Education and School of Social Sciences (Department of Cognitive Sciences), University of California, Irvine, Irvine CA 92697, [6]MIND Research Institute, Irvine CA 92617, [7]Department of Psychology, University of Wisconsin-Madison, Madison WI 53706, [8]Institut de la Vision, Sorbonne University, Paris, France

It has recently been hypothesized that the broad perceptual and cognitive enhancements induced by action video game (AVG) play relies partially on the ability to quickly learn a new task (i.e., 'learning-to-learn'; Bavelier et al., 2012). Here, we report convergent results supporting this hypothesis from three studies conducted at several distinct sites. In the first study, we recruited avid action video game players (AVGP, n=9) and non-video game players (NVGP, n=20) to perform a dual N-back working memory learning task. During the task, participants simultaneously performed an adaptive N-back task in both visual and auditory domains. We measured the N-back level reached in each of ten learning sessions. We found that AVGPs showed a higher learning rate than NVGPs. In the second study, we trained two groups of non-video gamers on action games (n = 14) or life/business simulation games (n = 11), respectively, for forty hours. Learning speed in the same N-back learning task was estimated after game training. We found that the action group learned faster than the control group, demonstrating a causal link between AVG experience and enhanced learning. In the third study, we replicated the same training experiment as above in 52 additional participants with low-to-moderate game experience, this time ensuring that experimenters were blind to group assignment. Again, faster learning was seen in the AVG trained group, particularly in participants with low initial game experience (the effect was in the same direction but non-significant in participants with more moderate previous game experience). In both Studies 2 and 3, we also found that individual differences in attentional control measured by a multiple-object-tracking task predicted participant's learning rate in the N-back task. Taken together, these convergent results provide evidence for the "learning-to-learn" mechanism as a new framework to conceptualize the broad learning generalization induced by AVG play.

Acknowledgements: Office of Naval Research award N00014-14-1-0512 (DB&CSG), Swiss National Foundation Grant 100014_140676 (DB), National Eye Institute EY020976 (DB), Center of Visual Science training grant EY001319, National Eye Institute Grant EY017491 (ZLL), and National Institute on Aging Grant 1K02AG054665 (SMJ).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1697

Behavioral and Neural Evidence that Visual Statistical Learning is Shaped by Task Demands and Categories

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Leeland Rogers[1] (leeland.rogers@gmail.com), Su-Hyoun Park[1], Timothy Vickery[1]; [1]University of Delaware

Visual statistical learning (VSL) describes humans' ability to incidentally extract temporal and spatial statistical regularities from visual information. VSL is often characterized as the result of always-on processes, constantly at work on the objects of attention. Yet, in the real world, task demands change constantly as a function of our immediate goals and the environment. Aside from basic manipulations of visual attention, however, little work has focused on how behavioral or neural markers of VSL are modulated by different task conditions. To examine this problem, we first had participants view sequences of fractal images in which image pairs were embedded (pair members always appeared back-to-back), while subjects were engaged in an arbitrary categorization task. Embedded pairs were either both of the same category or two different categories. In a surprise 2AFC test, Experiment 1 revealed that same-category pairs were learned better than different category pairs ($p = .01$). Experiment 2 used fMRI to examine whether task during familiarization modulates neural signatures identified by prior research. After being exposed to streams of images under different task demands (either 1-back or arbitrary category-mapping), participants were scanned while passively viewing a stream of the same images in a rapid event-related design. BOLD responses were modulated by both item order and training context; while activity in the Frontoparietal Network and Middle Frontal/Medial Prefrontal areas for images learned during the 1-back task was reminiscent of prior research, activity for images learned during categorization was not: cerebellar activity uniquely differentiated the second image of same/different category pairs. While previous research has overlooked the potential for task and context to influence VSL, we argue that it may dramatically influence behavioral and neural responses to statistical associations. As our task and efforts change throughout the day, incidental learning mechanisms such as VSL also adaptively change.

Acknowledgements: NSF OIA 1632849, NSF BCS 1558535

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1196

College Swimmers' Visual Timing Sensitivity

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Nestor Matthews[1] (matthewsn@denison.edu), Sophia Gaguzis[1], Anthony Bruno[1]; [1]Denison University

Introduction: The precision of visual timing can improve more through auditory training than through visual training. For example, musical training requires auditory sensory-motor synchronization (SMS), and musicians show finer visual timing sensitivity than do visual SMS experts (Matthews, Welch & Festa, 2018). College swimmers rely on auditory SMS to start each race. Diving into the pool before the starting beep automatically disqualifies a swimmer. Waiting too long after the starting beep puts swimmers at a competitive disadvantage, hence the swimmers' mantra "races are won or lost at the start". Successful swimmers minimize the asynchrony between the auditory sensation of the starting beep and their subsequent motor response. In principle, fine-tuning this auditory sensory motor asynchrony -an implicit temporal order judgment (TOJ)- might cross train the visual system, as it apparently does for musicians. This possibility motivated the present comparison between visual TOJs in college swimmers and age-matched controls. Method: We bilaterally presented plaids that either radiated or rotated before changing direction. Thirty-seven college swimmers and 37 age-matched controls reported whether the direction changed first on the left or right – a visual TOJ. In the control condition, participants reported whether the left or right plaid contained wider bars – a spatial frequency (SF) discrimination. Results: Swimmers exhibited significantly lower (better) temporal (TOJ) ranks than did controls ($p=0.007$; $Z=2.714$), yet these groups performed virtually identically on spatial (SF discrimination) ranks ($p=0.897$; $Z=0.130$). This significant task-by-group interaction disconfirms non-specific explanations (attention, motivation, motor errors) for the group difference. Conclusion: Prior SMS studies indicate that college swimmers are better than other athletes at visual time estimation (Bove et al., 2017), and that this superiority is specific to swim-stroke-expertise (Tobin & Grondin, 2012). Our findings suggest that swimmers' superior time estimation could reflect enhanced low-level visual timing sensitivity, presumably acquired through auditory SMS training.

Acknowledgements: Denison University summer research scholarships to SG and AB supported this research.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
21 June, 11:00 pm EDT America/New_York

Presenter's Message

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Abstract ID: 456

Cue scaffolding to train stereo-anomalous observers to rely on disparity cues

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Angelica Godinez[1] (agodinez@berkeley.edu), Santiago González[2], Dennis Levi[1]; [1]School of Optometry, University of California, Berkeley, [2]Construcción e Ingeniería de Fabricación, Universidad de Oviedo

Stereopsis plays an important role in everyday visuomotor tasks. However, abnormal visual experience during development may result in reduced or absent stereopsis. In recent years, laboratory methods have been designed to strengthen stereopsis in adults with abnormal binocular vision. However, these techniques require many trials and are often not engaging. Video games can be used to tackle these challenges. Several studies have reported benefits of using video games to improve both low- and high-level visual functions in the treatment of amblyopia. Furthermore, with recent commercialization of Virtual Reality (VR), depth cue scaffolding has become possible in this approach. Our aim was to test whether depth cue scaffolding in VR can be used to train stereo-anomalous observers to rely on disparity cues. We designed two VR games to train stereovision. Strabismic deviations were corrected using a virtual prism and dichoptic calibration sight, and input to the two eyes was perceptually balanced by reducing the luminance to the dominant eye. Thus, avoiding diplopia and/or suppression. One game required participants to launch a dart when a dartboard, moving in depth, was on the same depth plane as the dart. The other game required participants to destroy the nearest of several targets moving forward. Importantly, initially the games provided multiple cues for judging depth (shadows, perspective, motion parallax, and disparity). As participants progressed through the game, we selectively removed cues (shadows, perspective and motion parallax), finally leaving only disparity cues. Results show that most stereo deficient participants improved in the game, and several showed transfer to both clinical and psychophysical stereoacuity tests (Ding & Levi, 2011). Overall, participants with anisometropia reached a lower stereoacuity threshold at a faster rate compared to participants with strabismus. We conclude that cue scaffolding may be a useful tool for recovering stereopsis in adults with abnormal visual development.

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Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 300

Developmental changes to learning rates for novel perceptual priors

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Reneta Kiryakova[1] (reneta.k.kiryakova@durham.ac.uk), Stacey Aston[1], Ulrik Beierholm[1], Marko Nardini[1];
[1]Durham University

One challenge our brains face when making decisions is the inherently ambiguous sensory information they receive. Numerous studies have shown that adult observers overcome this challenge by combining their observations with their previous experience (priors) in way that can be close to statistical optimality (Berniker et al., 2010). However, children's abilities to do this are still developing to at least 9-10 years of age (Chambers et al., 2018). It is possible that children are slower at learning to use new priors than adults. We measured learning rates for priors in an "octopus catching" task, where adults and 6-11-year-old children judged the position of a "hidden" octopus, drawn from a Gaussian distribution with a narrow variance. To accurately predict the location of the octopus, subjects could combine their prior expectations of where the octopus is likely to appear with a noisy sensory cue, a single dot from a Gaussian distribution. The prior variance increased halfway through the experiment to test how participants learned to adapt their behaviour in response to this change of prior. We determined the relative weight given to the prior as compared with the optimal weight. We found that adults showed greater reliance on the prior as the study progressed, approaching Bayesian predictions. Further, adults responded to a switch in the prior variance almost immediately, as shown by a rapid re-weighting of the prior information. In contrast, children were slower to approach the optimal prior weight, and to re-weight the prior during the second half of the experiment. We also found 6-8 year-olds to be slower than 9-11-year-olds, highlighting the developmental trajectory of the ability to integrate expectations in their perceptions. In conclusion, our results suggest that learning to use and weight novel statistical regularities is a major contributor to difficulties with performing Bayesian computations in childhood.

Acknowledgements: Leverhulme Trust grant RPG-2017- 993 097 and North East Doctoral Training Grant ES/J500082/1

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 812

Novel mechanisms of rapid reactivation-induced perceptual learning

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Taly Kondat[1] (talykondat@mail.tau.ac.il), Shachar Gal[1], Haggai Sharon[2], Ido Tavor[1], Nitzan Censor[1]; [1]Tel Aviv University, [2]Tel Aviv Sourasky Medical Center

Perceptual learning is enabled by repeated practice. However, extensive practice is not the only route to make perfect: adapting memory reactivation-reconsolidation frameworks predominantly originating from fear-conditioning modulation studies in rodents, we showed that brief reactivations of the encoded visual skill memory are sufficient to improve human perceptual thresholds (Amar-Halpert et al., 2017). Here, we aimed to reveal the underlying mechanisms of reactivation-induced perceptual learning. We reasoned that in contrast to use-dependent plasticity dominant in early visual areas, engagement of high-level regions mediates rapid perceptual learning, which in turn predicts facilitation of generalization patterns of learning. To test this prediction, participants performed the texture discrimination task (Karni and Sagi, 1991), in which they decided whether an array of 3 diagonal bars embedded in an array of horizontal bars was horizontal or vertical. The stimulus was backward-masked, and target-to-mask asynchrony (SOA) was randomly changed within the session to obtain a psychometric curve, from which the SOA discrimination threshold was derived. Baseline performance was first measured in two target-array locations: upper left (location B) and lower right (location A) quadrants of the visual field. Participants returned for 3 daily location A reactivation sessions of only 5 trials each, at a near-threshold SOA. Final thresholds were measured in the "reactivation-trained" location A and the untrained location B. Results indicate full learning in location A, replicating reactivation-induced learning. Furthermore, reactivation-induced learning transferred to the untrained location B, exhibiting reduced thresholds relative to baseline. To further evaluate the systems-level mechanisms of reactivation-induced learning and generalization, task-based and resting-state fMRI are measured before and after learning, analyzing engagement of higher-level regions and their communication with early visual areas. Together, the results suggest that reactivation-induced plasticity may unlock learning specificity and facilitate generalization patterns of learning.

Acknowledgements: This work was supported by the I-CORE Program of the Planning and Budgeting Committee and the ISF (grants 51/11 and 526/17), and by the United States-Israel Binational Science Foundation (BSF, grant 2016058)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 518

Rapid reorganization in adult human primary visual cortex (V1) and consequent perceptual elongations are mediated by GABA

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Guldehan Durman[1], Yaseen A. Jamal[1], Derek Hu[1], Eva M. Ratai[2], Daniel D. Dilks[1]; [1]Emory University, [2]Harvard Medical School

When deprived of its typical visual input, the adult human primary visual cortex (V1) starts to reorganize within minutes, directly affecting visual perception (e.g., squares are perceived as rectangles). But what is the mechanism underlying such rapid neural and perceptual changes? Here we use magnetic resonance spectroscopy (MRS) and psychophysics to show that the inhibitory neurotransmitter, GABA, is the initial driver of reorganization in adult human V1. Specifically, we patched one eye in typical children, adults, and seniors, thereby depriving the cortical representation of the blind spot (BS) of its typical visual input. In adults, using MRS, we then found a significant reduction in V1 GABA concentration within just minutes of deprivation (relative to no deprivation), and, moreover, that this magnitude of GABA reduction closely predicted the extent of perceptual distortion near the BS after deprivation. Additionally, using psychophysics, we found that the magnitude of such perceptual distortions was reduced in kids and seniors relative to adults, thus mirroring the inverted U-shaped pattern of V1 GABA concentration across the lifespan. Taken together, these results provide converging neural and behavioral evidence that the disinhibition of preexisting connections ignites rapid cortical reorganization in the adult human visual system, and raise the intriguing question of whether and how additional changes continue to occur during subsequent, longer periods of deprivation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 288

Statistical learning of concurrent auditory signals

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Jozsef Fiser[1,2] (fiserj@ceu.edu), Tunde Szabo[1,2], Benjamin Markus[1,2], Marton Nagy[1,2,3]; [1]Central European University, Budapest, Hungary, [2]Center for Cognitive Computation, Budapest, Hungary, [3]Eotvos Lorand University, Budapest, Hungary

Due to the highly sequential nature of auditory information and its close link to speech in humans, auditory statistical learning (SL) has been viewed predominantly as a special learning related to segmentation in language development. Meanwhile in other modalities, SL has been conceptualized as a general-purpose learning ability of information presented in parallel, which is crucial for developing internal representations used by everyday behavior. To resolve this discrepancy, we investigated whether being exposed to brief

auditory stimuli presented concurrently without any sequential structure across trials would lead to the same sort of automatic statistical learning as reported earlier with complex spatial patterns in the visual modality. Eight unique sound-segments were created by modifying everyday sound patterns such as rolling marble balls, dropping objects, etc., which were paired into four sound pairs. Following the standard SL paradigm, familiarization auditory “scenes” were created by randomly pairing two of the pairs for each scene so that elements of a pair never appeared without each other during the familiarization, but they were paired with all other sounds equally often. Thirty-six participants (Exp1=14, Exp2=22) listened to the sequence of 360 scenes in random order, to all four segments of each scene together for 1.5 sec, without any instruction beyond asking to pay attention. Next, in the test session, participants chose which of two sound pairs (a true pair vs. a random combo) sounded more familiar. In Exp1, sensitivity to joint probability, in Exp2, sensitivity to conditional probabilities of sounds were tested. In both experiments, participants showed a significantly above-chance preference ($p<0.001$) for the pairs with a higher joint/conditional probability, fully replicating earlier results obtained in the visual domain. This suggests that rather than being specially language-related, auditory information is used by general-purpose SL for shaping internal representation the same way as in other modalities.

Acknowledgements: This work has been supported by the grant ONRG - NICOP - N62909-19-1-2029.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 444

attention guidance by object location associations

Poster Presentation - *Topic area: Plasticity and Learning: Statistical learning, applications*

Ziyao Zhang[1] (ziz418@lehigh.edu), Nancy Carlisle[1]; [1]Lehigh University

Spatial and featural attention have typically been studied separately. However, we know from scene research that search for particular items can be focused on likely locations, like a mug on a counter. These object-locations associations are learned through a lifetime of experience, but in our research we wanted to determine if these object-locations associations could be learned and lead to attentional effects within a single experimental session through statistical learning. In 4 experiments, we assessed the effect of object-location associations on visual attention. In the experiments, a visual cue indicated the target object in each trial. Critically, we created specific positional regularities of objects. In Experiment 1-3, each target object

appeared at one location on 80% of trials (high probable location, HPL) and at another location on 20% of trials (low probable location, LPL). In Experiment 4, each target could appear at all 4 locations with different probabilities (40%; 25%; 25%; 10%). Importantly, target location was counterbalanced so overall target probability was equal at all locations. Experiment 1 showed targets at HPLs led to faster RTs than targets at LPLs. Experiment 2 showed that the effects in Experiment 1 were not due to recency, through an equal probability testing period. With a probe technique, Experiment 3 further showed that positional regularity influenced early attention selection independent of later object recognition. With a more complex object-location manipulations, Experiment 4 revealed that instead of only prioritizing the highest probability location, the visual system can pick up more complicated probability manipulations between locations and prioritize accordingly. With an awareness test, Experiment 4 also showed the effect of positional regularities occurs regardless of whether participants have explicit knowledge. These results demonstrate object-location associations can be formed, and guide attention, on the timescale of typical statistical learning.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 179

Scene Perception: Categorization, environments, memory

A real-time model of retinal stimulation in virtual environments

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Daniel Panfili[1] (dan.panfili@utexas.edu), Karl Muller[1], Mary Hayhoe[1]; [1]University of Texas at Austin

The experimental control granted by virtual reality (VR) allows investigation of complex behaviors involving naturalistic stimuli. VR engines provide direct access to the images viewed by subjects, facilitating analyses of image properties that are often difficult to extract from real scenes. For example, current computer vision algorithms of optic flow are often inaccurate in complex scenes with significant depth variations. We have developed a prototypical model of the eye to allow for real-time recording of visual stimuli projected onto the retina from the virtual environment. The Panfili Functional Eye (PFE) model uses real-time ray tracing to compute the optic flow stimuli rendered by the VR engine. The PFE uses a pinhole model of the

eye with refraction, with input parameters designating resolution, field of view, and movement method. An array of virtual photoreceptors is generated along the surface of a virtual retina. The virtual photoreceptors cast rays through the pupil, where refraction is applied using Snell's Law. These rays are then cast out to the virtual environment, returning information such as world position, normal of the vector, and coordinates on the UV/Lightmap of the object. The primary goal of the model is to describe the geometric projection of the virtual environment onto the retina in real-time. High-fidelity and low-latency retinal modeling has not been previously possible due to the technical limitations of ray tracing. The model performs as much as 150 times faster than comparable methods, a metric which should increase exponentially with the use of parallel processing. The PFE is modular to allow for the incorporation of more complex optical models, simulating eye conditions, and the analysis of other visual features. Our current application uses the model to compute optic flow patterns of experimental stimuli contingent on direction of gaze while subjects walk freely in a virtual environment.

Acknowledgements: NIH Grant EY05729

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1566

Assessing Distance Estimation in Brief Viewing Durations in Virtual Reality

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Lindsay Houck[1] (lindsayhouck@gwmail.gwu.edu), John Philbeck[1]; [1]The George Washington University

At views <100 ms, distance underestimation is common. Underestimation is reduced if longer views precede the brief exposures, suggesting a role for memory, yet the mechanisms remain unclear. Virtual environments (VEs) could accelerate this research, due to their widespread accessibility, but unexplained differences between VE versus real world perception raise the possibility that the time course of distance perception in VE may also differ from real world environments. To assess this, Experiment 1 (n = 38) presented cone targets on the floor of a 10x10 m room in an Oculus VE. Participants verbally estimated cone distance (2.2-9.8m). Viewing duration (100 vs. 5000 ms) was manipulated in counterbalanced blocks. Following real-world results, we expected greater underestimation under 100 ms views, but only if preceding the 5000 ms block. Surprisingly, there was slightly LESS underestimation at 100 ms durations,

irrespective of block order (p=.009). This suggests underestimation in VE may be partially due to gradual extraction of flatness cues. To reduce performance at 100 ms, Experiment 2 (n = 19), used a target sphere of constant angular size, removing relative angular size. Two blocks of 100 ms glimpses with targets 4.8-30 m distant were interspersed with a 10 sec view of the 10x40 m environment; we expected improvement following the longer glimpse. A third block of 5000 ms views established asymptotic performance. Results showed improvement in block 3 from blocks 1-2 (both p's<.03), but not blocks 1-2. This suggests that memory of the VE does not facilitate performance in subsequent short duration trials. Underestimation in asymptotic performance was greater in experiment 2, suggesting that relative angular size is a particularly strong cue in VEs. Future work will determine whether the differing patterns here versus past real-world results are due to response mode differences, or instead to bona fide perceptual differences.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1705

Change Blindness in a Virtual Arcade

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

D. Alexander Varakin[1] (donald.varakin@eku.edu), Cindy Vasquez-Caballero[1], Madison Major[1], Jon Phillips[1]; [1]Eastern Kentucky University

Change blindness (CB) occurs when observers fail to notice changes that occur from one view to the next. CB has been demonstrated using many different stimulus types (shapes, pictures, movies, real objects) in a many different contexts (from laboratory to "on the street"). The current experiment utilized virtual reality (VR) to explore incidental detection of changes that could not easily happen in the real world. Participants (N = 73) played a version of a "whack-a-mole" game in a VR arcade. Before or after playing the game, text on the front wall of the arcade instructed participants to look at the posters on the walls on the left and right side of the room. The instructions ensured each wall was looked at twice, and head rotation was tracked to ensure participants complied. Unbeknownst to participants, different attributes on the left and/or right wall changed across views: one set of posters changed in spatial configuration and one wall changed color. Changes occurred while participants looked in the direction opposite of the changing feature, ensuring the changes would not capture attention. Participants were later asked a series of yes/no questions about which objects in the virtual environment had changed. Correcting for false alarms, only about 15% of changes were detected. Whether the changes occurred on the same or different sides of the room did not matter. Hit and false alarm rates were similar for posters changing configuration and walls

changing color. Moreover, detection of one change was independent of detecting the other. Pre- and post-change looking duration predicted detection of wall color changes (weakly), but not poster configuration changes. Overall, the results are inconsistent with the idea that spatial configuration changes are better detected than other visual changes, but consistent with the idea that different features of the visual world are represented independently.

Acknowledgements: This work was supported by the University-Funded Scholarship program at Eastern Kentucky University

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

There is a link to a YouTube video of a demonstration of the experiment in the pdf file.

Abstract ID: 740

Effects of spatial layout and object content on visual scene recognition

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Jacopo Turini[1] (turini@psych.uni-frankfurt.de), Melissa L.-H. Vo[1]; [1]Goethe University

Recognizing the environment around us is a fundamental step that our cognitive system performs to efficiently accomplish tasks like object recognition, search and navigation. Despite being complex stimuli, scenes are recognized quickly and accurately. There is evidence showing that this efficiency relies mainly on a global representation which preserves the spatial layout of a scene, discarding information about the object content. However, some objects within a scene have a strong importance in defining the semantics and layout of that context. These objects, called “anchors”, are generally bigger, not very moveable, and hold prediction about the presence and location of other objects. In this study, we compared recognition performance for scenes varying in the availability of spatial layout and object content, e.g. 1) multiple isolated anchors left in their natural arrangement (preserving spatial information while adding content information), 2) spatially rearranged anchors (natural spatial layout is disrupted, but content information remains present), 3) global textures of these scenes (preserved spatial layout, but no meaningful content). In a behavioral experiment, we briefly presented participants with images of scenes containing different levels of spatial and content information and asked them to categorize the stimuli. The scene was followed by the image of an object, either semantically consistent or inconsistent with the scene. Results show that

scene recognition performance was not substantially diminished compared to full scenes when only showing isolated anchors, however rearranging them led to drops in performance. The mere layout of the scene without object content further decreased performance to chance level. The semantic consistency of objects following scene presentation affected all scene conditions but exhibited greatest effects when no content was present in the scene. We conclude that scene recognition relies on both content and spatial information and highlight the role of anchors in bringing together these two fundamental dimensions.

Acknowledgements: This work was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 222641018 – SFB/TRR 135, sub-project C7 to MLV.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1070

Exploring how broad associative thought enhances scene gist perception

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Shira Baror[1] (baror.shira@gmail.com), Moshe Bar[1], Elissa Aminoff[2]; [1]Bar Ilan University, [2]Fordham University

While perceiving the external environment, people also engage in internal trains of thoughts - thoughts ranging from narrow and ruminative to broad and creative. Both associative thought and perceptual gist-processing were previously suggested to rely on similar contextual mechanisms, but their cross-modal interaction has not been charted yet. To that aim, we explored whether associative thought patterns influence scene-gist perception. Two experiments manipulated same/different judgments in a 1-back visual task. Scene images were identical, completely different, or different yet similar in their gist to the preceding image. Simultaneously, associative thought was manipulated via chains of words, superimposed on the images. Consecutive words were either connected by a broad association (e.g., wolf-moon-stars) or were narrowly connected (e.g., dog-cat-puppy). An additional condition involved neighboring words that were completely unrelated to one another. To verify attention to the thought manipulation during the perceptual task, experiment 1 required participants to remember the words for a following memory test.

The main result shows that while on the first block gist-related performance was mostly deteriorated under the broad thought condition, by the last block perceptual performance in the broad condition was significantly facilitated and most rapid. To further dissociate the possible effect of associative thought from memory load, experiment 2 did not involve an explicit word memory test. Nonetheless, the results replicate the findings from experiment 1, showing that under the broad thought condition, gist-related perceptual performance was facilitated as the experiment progressed. To conclude, exploring the relationship between thought and perception is fundamental to understanding how sensory and mental aspects comprise our unified experiences. We show that the pattern of thought influences how we perceive and categorize our sensory world and demonstrate a cross-modal enhancement of scene gist processing during broad associative thought. We propose that this results from shared contextual associative psychological mechanisms.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 620

How we perceive ensemble statistics and how they serve memory representation

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Shaul Hochstein[1] (shaulhochstein@gmail.com), Noam Khayat[1], Marina Pavlovskaya[2], Stefano Fusi[3]; [1]Hebrew University, Jerusalem, [2]Lowenstein Rehabilitation Center, Raanana, Israel, [3]Columbia University, New York

Perceiving ensemble statistics, the mean and range of stimulus sets, has been the subject of great recent interest. Clearly, when there is too little time to see too much, perceiving the gist or Gestalt of a scene in terms of its statistics, facilitates overcoming visual system and memory capacity limits. It is now clear that we perceive stimulus set mean and range of size, brightness, color, orientation, facial emotion, lifelikeness, and known or novel category. Set perception is rapid, automatic, implicit and on-the-fly. But how can the brain compute the mean of a series of stimuli without representing the individual set members? We propose that the well-studied neural population code, coupled with ubiquitous broad receptive fields, solves this dilemma directly. The overlapping broad receptive fields for responses to set individuals prevents their individuation but expedites perception of their population mean. Only with focused attention can individuals be perceived. However, overcoming perceptual limitations is but half the story,

because object representation and memory also have their limits, and even gradual accumulation of information can overload these systems. Benna and Fusi (2019) recently suggested that memory representation is compressed when related elements (called “descendants”) are represented in terms of their mean (progenitor or “ancestor”) and the difference of each from it. Applying this theory to ensemble statistics, we conclude that mean perception may be no more than an epiphenomenon of an essential generalized mechanism for memory compression. Implications will be demonstrated and discussed.

Acknowledgements: Israel Science Foundation (ISF)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 516

Measuring the visual pedestrian qualities of urban streets through crowdsourcing

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Kyoung Whan Choe[1] (kywch@uchicago.edu), Emily Talen[1], Marc Berman[1]; [1]The University of Chicago

We experience our neighborhoods and cities through our streets. An essential question is what street features contribute to a superior pedestrian experience? Further, can interacting with urban streetscapes improve cognitive functioning, as interacting with nature does? To answer these questions, large urban street perception databases are enormously helpful. Toward this end, we propose a crowdsourcing method for measuring the pedestrian qualities of streets – preference, imageability, complexity, enclosure, human scale, transparency, and order, all of which are important design dimensions for pedestrian experience. We obtained 556 street images from Google Street View by sampling two sidewalk images from 278 geo-coordinates in Chicago. For each dimension, over 58 (SD=2.5) Amazon Mechanical Turk workers (469 in total) completed an image rating task for the 556 images. In each trial, participants were shown 12 images in a 4x3 grid and asked to choose four images that they evaluate highly on that dimension. The probability of selecting each image for a given dimension across participants was used to quantify how much that image represented that dimension. To test the inter-rater reliability, we randomly split participants into two groups 2000 times and calculated rank-correlations between the measures from each group. We found that the split-half correlations were high for walkability (0.86±0.01; M±SD), preference (0.83±0.02),

imageability (0.78±0.02), complexity (0.79±0.02), enclosure (0.80±0.02), and transparency (0.88±0.01) and modest for human scale (0.45±0.05) and order (0.57±0.05). To test whether the measures are internally consistent, we randomly split two images from the same geo-coordinate into two bins (of 278 images) 2000 times, calculated rank-correlations, and found modest to low correlation values, range: [0.06, 0.37]. These results suggest that our method can be used to efficiently measure pedestrian street qualities from non-experts, but with some limitations, to build a large database for studying street features affecting urban street pedestrian experiences.

Acknowledgements: The University of Chicago Social Sciences Research Center Faculty Seed Grant Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

Hello and thank you for visiting my poster!

To try the multi-image rating task, please visit this link -->
https://kywch.github.io/StreetPsych/rating_preference.html

To look and sort the street images, please visit this link -->
https://kywch.github.io/StreetPsych/visualize.html

I look forward to chatting with you. Thank you!

Abstract ID: 929

Predictability facilitates rapid scene processing: a behavioral and ERP study.

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Dominic McLean[1] (d.mclean@uea.ac.uk), Louis Renoult[1], George L Malcolm[1]; [1]University of East Anglia

Scene meaning can be processed extremely quickly, with 'gist' extracted even when presentation duration spans only a few dozen milliseconds. This has led some researchers to suggest a primacy of bottom-up information (e.g., Potter et al., AP&P, 2014). However, gist research paradigms have often relied on

showing a succession of single, unrelated scene images. This contrasts with our everyday experience in which the world gradually unfolds around us in a predictable manner. Thus, we investigated whether top-down information – in the form of observers' predictions of an upcoming scene image – facilitates gist processing. If so, predictable scenes should be categorised more readily. Alternatively, if gist primarily relies on bottom-up information then predictability should have a minimal effect. We provided participants (N=129) with five sequential scene images, organised to represent a journey through an environment (e.g., walking down a sidewalk). A final target scene was then presented, either congruent or incongruent with the destination of the journey (e.g., a store interior or a bedroom), followed by a 6AFC response screen. Target scenes were presented for a limited duration (35-250ms), allowing us to delineate the influence of predictions on scene processing over time. As hypothesised, congruent trials were associated with significantly higher performance, especially at shorter durations. We then investigated the neural signature of predictability on scene processing using ERP (N=26), with the same paradigm except with target scenes shown for 1s. Differences were found in the scene-selective ERP marker related to integrating visual properties (P2 component), as well as later components related to contextual regularities including semantic and syntactic meaning (N400 and P600, respectively). Taken together, these results strongly suggest that in real-world situations, top-down predictions of an upcoming scene influence even the earliest stages of its processing, affecting both the integration of visual properties and meaning.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for your interest in our research.

Feel free to email me at d.mclean@uea.ac.uk if you'd like to get in touch.

Abstract ID: 1189

Revisiting the Impact of Perception on Tasks of Emotionally-Enhanced Vividness

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Logan Doyle[1] (logan.doyle@mail.utoronto.ca), Susanne Ferber[2]; [1]University of Toronto

Previous research has identified that emotional scenes are reported as more vivid than neutral ones, a phenomenon referred to as emotionally-enhanced vividness (EEV). Explanations of EEV point to perceptual or attentional processes for this relationship but did not sufficiently rule out the possibility of a memory bias in reporting the results. To investigate the contribution of perception and memory to tasks examining

EEV, we asked participants to view emotionally salient images of negative valence or neutral greyscale images, each with a different level of applied noise as stimuli. After a brief retention interval, the test image was shown onscreen alongside a slider. Participants responded by moving the slider to add noise to the test image until it matched the remembered presentation. In the first experiment, the stimulus and test image were the same. Contrary to previous research, participants in this experiment applied significantly more noise to emotional images compared to neutral images. To elucidate whether this was driven by impaired memory of the stimulus or better perception at test, the second experiment varied the test image independently from the stimulus image. In this experiment, participants rated only neutral stimulus images followed by emotional test images as significantly noisier than any other condition, suggesting that the emotional test image at response was perceived as more vivid than a neutral one. These findings suggest that EEV does occur at the level of perception but that these enhancements are not passed on to subsequent memory for the same scene.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hi! Thank you for checking out my poster. I would love to talk about this work; if you have any comments, suggestions or questions, please contact me at Logan.Doyle@mail.utoronto.ca and we can organize from there!

All the best!
-Logan

Abstract ID: 719

Serial Dependence in Immersive Virtual Environments

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Kyriaki Mikellidou[1], Kleanthis Neokleous[2,3], Marios Avraamides[1]; [1]Department of Psychology and Center for Applied Neuroscience, University of Cyprus, Nicosia, Cyprus, [2]Silversky3D, Nicosia, Cyprus, [3]Research Centre on Interactive Media Smart Systems and Emerging Technologies, Nicosia, Cyprus

The uninterrupted experience of our visual world seems to be maintained effortlessly and seamlessly by our visual system. One of the mechanisms facilitating this temporal continuity is serial dependence (SD), which makes successive stimuli appear more similar than they really are. The human brain appears to be sensitive to the abundance of serial correlations in visual scenes, inducing strong drifts in observer responses towards previously seen stimuli. SD effects have been studied with a wide variety of stimuli, including orientation and numerosity patches, facial expressions and many more. Cicchini et al. (2018)

showed that the prominence of SD depends on the similarity between successive stimuli leading to a two-fold functional advantage by minimizing reproduction errors and yielding faster reaction times. Here, we investigate whether SD effects are evident under realistic conditions by presenting three-dimensional stimuli in immersive virtual reality environments in the near-central (7.5 degrees) and peripheral (30 degrees) visual field (N=20). When the visual sensitivity for stimuli is equalized between the centrally and peripherally presented stimuli, in terms of just-noticeable-difference, SD effects are of equal size and also similar to those observed under typical experimental conditions using simple Gabor patches (10%). The results of this study show that SD effects are evident in immersive environments both in the near-central and peripheral visual field, demonstrating the potential importance of such a mechanism in everyday life.

Acknowledgements: **This research is supported by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement 'Peripheality' no. 797603

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for passing by :) Let me know if you have any questions or comments!

Abstract ID: 1178

The role of reference frame in panoramic scene memory

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Dongheon Kham[1] (khamdong@yonsei.ac.kr), Hee Kyung Yoon[1], Yoonjung Lee[2], Soojin Park[1]; [1]Yonsei University, [2]Johns Hopkins University

How do we construct a seamless visual experience despite changes in the current view? Recent studies suggest that overlapping visual content between individual views plays a key role in forming panoramic scene memory. What reference points are used when integrating individual views into a panoramic representation? In the current study, we tested the effect of the overlapping visual experience in two different types of reference points: viewer-centered and scene-centered. In each trial, participants viewed two short clips sampled from a 360° panoramic environment. In the viewer-centered condition, the view changed as if the viewer rotated the head to survey the environment in a fixed position. In the scene-centered condition, the view changed as if the viewer revolved around an invisible pivot inside the scene. In each condition, the two clips either shared a portion of the visual content (Overlap Condition) or not (No-Overlap Condition). In the following memory test, participants were asked to determine whether the two snapshot images from the opposite poles of the studied environment were drawn from the same place. Our results show higher panoramic scene memory performance for the images presented in the Overlap

Condition compared to the No-Overlap Condition, replicating previous findings. Importantly, the overlap effect was significantly greater in the viewer-centered than in the scene-centered reference point condition. These results demonstrate that reference point information is utilized along with visual overlap cues when integrating scenes in memory, suggesting a potential role of a viewer-centered reference frame in constructing a coherent visual experience.

Acknowledgements: This work was supported by National Eye Institute (NEI) grant (R01EY026042), National Research Foundation of Korea (NRF) grant (funded by MSIP-2019028919) and Yonsei University Future-leading Research Initiative (2018-22-0184) to SP.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for checking out my poster presentation! Should you have any questions, please contact me via email(khamdong@yonsei.ac.kr). I'd be more than happy to answer and also listen to your feedback!

Abstract ID: 643

Who’s chasing who? Adults' and infants' engagement of quantificational concepts (“Each” and “All”) when representing visual chasing events.

Poster Presentation - *Topic area: Scene Perception: Categorization, environments, memory*

Nicolò Cesana-Arlotti[1] (nicolocesanaarlotti@gmail.com), Tyler Knowlton[2], Jeffrey Lidz[2], Justin Halberda[1]; [1]Department of Psychological and Brain Sciences, Johns Hopkins University, Baltimore, MD, [2]Department of Linguistics, University of Maryland, College Park, MD

The human mind compresses rich visual experiences into simpler constructs. At the interface between vision and cognition, such compression may engage categorical representations (e.g., RED, AGENT, CHASING) and may tap into logically structured categories (e.g., ALL, EACH). To shed light on the nature and ontogenesis of the mental computations that link vision with abstract logical concepts, we tested adult’s and 10-month-olds infant's capacity to encode visual scenes of exhaustive-collective actions (e.g., All of the wolves chased a sheep together) or exhaustive-individual actions (e.g., Each of the wolves cased a sheep by himself). In Experiment 1, adults were asked to describe movies in which chevron shapes were seen to "chase" moving balls in a MOT design (see Fig.1). Adults spontaneously used the word "All" to describe movies where the chevrons all pursued a single ball together and "Each" for movies where each chevron chased its own ball. Crucially, the use of "Each", but not of "All", significantly decreased when there were

more than three chasers. This suggests that "Each" piggybacked on the representations of multiple discrete individual events – i.e., MOT (within the capacity of working memory), while "All" piggybacked on the representation of a single collective event – i.e., ensembles. In Experiment 2, we asked if these representations are in place early in life, using visual habituation to test 10-month-olds (see Fig.2). Infants who were habituated to the "All" movies with three chasers successfully dishabituated to the "Each" movies with three chasers, and vice versa. We are currently testing the limits of infants' representations of "All" and "Each" actions by habituating them to movies with five chevrons. These findings begin to reveal that the concepts expressed by "All" and "Each" integrate with rich visual scenes trough distinct computations and that these computations might be in place early in life.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1549

Scene Perception: Models and mechanisms

A geometric state-space framework reveals the evoked potential topography of the visual field

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Bruce C. Hansen[1] (bchansen@colgate.edu), Michelle R. Greene[2], David J. Field[3]; [1]Colgate University, Department of Psychological & Brain Sciences, Neuroscience Program, [2]Bates College, Neuroscience Program, [3]Cornell University, Department of Psychology

Voxelwise encoding models of blood oxygen level-dependent (BOLD) signals offer insight into how information at different visual field locations is simultaneously represented in visual cortex. Here, we sought to extend this modeling approach to visual evoked potentials (VEPs) measured at different scalp locations by capitalizing on the principles of the cruciform model (Jeffreys and Axord, 1972a,b). However, using raw VEPs to simultaneously map the visual field to the scalp topography of EEG electrodes would result in overlapping components that differ in polarity as a function of visual field location. What that means is that a complete simultaneous topographic mapping of the visual field would be largely obscured by dipole cancellation. To circumvent this problem, we mapped the localized outputs of a log-Gabor filter encoding model to different VEPs within a geometric state-space framework. Specifically, we measured the

correspondence between the state-space geometry produced by our encoding model at every location within large-field visual scenes and the state-space geometry of VEPs measured at each electrode on the posterior scalp. Data were gathered in a standard VEP paradigm whereby participants (n = 23) viewed 150 grayscale scenes (18.5 degrees of visual angle) while undergoing 128-channel EEG. The encoding model state-space produced at each location of the visual field was then regressed against the neural state-space produced at each time point for each electrode. The results show that each posterior electrode can be simultaneously mapped to unique regions of the visual field, with a complete map of the entire visual field represented across all posterior electrodes starting at 75msec post-stimulus onset. The success of this state-space mapping approach suggests that it is possible to use evoked potentials to assess the temporal encoding of visual information at different locations within the visual field, thereby providing insight into visual feature usage over space and time.

Acknowledgements: James S. McDonnell Foundation grant (220020430) to BCH; National Science Foundation grant (1736394) to BCH and MRG.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for taking the time to view our poster! There is a video resource for this poster. The link to that video is embedded in the poster, but we're providing it here for simplicity:

https://drive.google.com/file/d/1h9j2zvv5yUcWBeG4cYR7KtGqSxbSPGQS/view?usp=sharing

We hope that you are able to attend one of our presenter conferences!

Abstract ID: 1652

Application of Deep Neural Networks to Model Omnidirectional Gaze Behavior in Immersive VR

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Thomas L. Botch[1] (thomas.l.botch@dartmouth.edu), Erica L. Busch[1], Caroline E. Robertson[1]; [1]Dartmouth College

Convolutional neural networks (CNNs) are powerful computational tools for understanding visual cognition, including human gaze behavior (O'Connell et al., 2018). Traditionally, CNNs are designed to model visual images that typically represent a single field-of-view. Yet, the naturalistic visual world extends 360° around us, and information often extends beyond one discrete field-of-view to surrounding areas of the environment. Recent advances in virtual reality (VR) head-mounted displays, integrated with in-headset eyetrackers, provide the ability to emulate the natural 360° environment with greater stimulus control while simultaneously recording participant's gaze. Here, we illustrate a method of leveraging any existing, pre-trained CNN to provide inferences about 360° naturalistic scenes, and demonstrate the application of these omnidirectional CNN activation maps in providing insight about gaze behavior in immersive virtual environments. First, single fields-of-view are evenly sampled from the equirectangular projection of the omnidirectional image and spherical distortions are removed through gnomonic projection. Next, CNN activation maps are generated for each field-of-view, and CNN layer activations in response to these images are recombined to create an aggregate equirectangular image. Finally, the aggregated equirectangular image is smoothed using a variable width gaussian kernel to account for projection distortions to produce maps. In a set of 20 individuals, we demonstrate comparisons of 360° gaze behavior with CNN layer activations of image salience (SalNet; Pan et al., 2016), memorability (AMNet; Fajtl et al., 2018), and semantically meaningful image features (VGG; Simonyan et al., 2014). All in all, we outline a method for extending existing CNN activation maps to omnidirectional images, and show the utility of these maps for predicting gaze behavior in real-world, omnidirectional environments.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Hi everyone,

Thanks for stopping by my poster! Please find external links to the poster below:

Poster: https://tinyurl.com/y9rsppnn
Video Presentation: https://tinyurl.com/y7x2zuv8

If you have any questions, or if you cannot make it to any of scheduled presenter conferences, please reach out to me:

Email: thomas.l.botch@dartmouth.edu
Twitter: @tommy_botch

Best,
Tommy

Abstract ID: 1399

Assessing the time course of saliency and meaning: Representational similarity analysis of ERP responses to natural scenes

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

John Kiat[1] (johnemmanuelkiat@gmail.com), Taylor Hayes[1], John Henderson[1], Steven Luck[1]; [1]University of California-Davis

Low-level visual saliency is widely thought to control the allocation of overt attention within natural scenes. However, recent research has shown that the presence of meaningful information at a given location may trump saliency. Here we used representational similarity analysis (RSA) of ERP responses to natural scenes to examine the time course of the neural representation of saliency (assessed using the Graph-Based Visual Saliency model) and high-level meaning-based representations. Participants (N = 32) viewed a series of 50 different scenes, continually maintaining the most recent scene in memory. We computed the correlation between the spatial distribution of low-level salience, the correlation between the spatial distribution of higher-level meaningfulness ("meaning maps"), and the correlation between the ERP scalp distributions, for all the scenes. As we had 50 different scenes, we were able to compute a 50x50 "representational similarity matrix" (correlation matrix) for saliency, for meaning, and for each time point in the ERP waveform. We then analyzed how the relationship between the scene-related similarity matrices and the ERP-related similarity matrix evolved over time. We found that a link between the saliency-based representational space and ERP representational space emerged first (ca. 80 ms), but that a link to the meaning-based representational space emerged soon afterward (ca. 100 ms). These findings are in line with biological models of saliency and low-level visual feature processing, suggesting that meaning-related computations arise after saliency-based computations, but early enough to suppress saliency in controlling overt attention.

Acknowledgements: This work was made possible by NIH Grant R01MH076226, NIH Grant R01MH065034 and NIE Grant R01EY027792

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1629

Computational measures of perceived image complexity correspond to neural activity in early visual cortex

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Elizabeth Yue Zhou[1], Claudia Damiano[2], John Wilder[1], Dirk B. Walther[1,3]; [1]University of Toronto, [2]KU Leuven, [3]Samsung Artificial Intelligence Center Toronto

Visual complexity is important for many aspects of perception, yet there is a lack of consensus over the best way to objectively measure it. Here we propose two computational methods for measuring perceived complexity of an image. The first method is based on Multiscale Entropy (MSE), which has mainly been used on time series. We decomposed the image into layers of various spatial scales, and computed Shannon entropy at each scale. The second method is based on PNG file size with rotations. We computed PNG file size at each 90° rotation of an image and took the minimal size, since the original PNG encoding does not account for spatial dimensions of the image. We collected subjective complexity ratings from Amazon Mechanical Turk for 6929 images from BOLD5000 and SUN, and included the clutter image set from Talia Konkle's lab. Both the MSE method (Pearson's r: BOLD5000 = 0.17; Scenes = 0.25; Clutter = 0.42) and the PNG method (Pearson's r: BOLD5000 = 0.24; Scenes = 0.37; Clutter = 0.63) are positively correlated with human ratings. The PNG method with image rotation yields better performance than the PNG file size without rotation (Pearson's r: BOLD5000 = 0.20; Scenes = 0.35; Clutter = 0.47), which is significant for clutter image set but not for BOLD5000 or Scenes. Furthermore, we performed a model-based regression analysis of the BOLD5000 fMRI data with human ratings, the MSE method and the PNG method as regressors. The computational models are associated with activation in V1 to V4, whereas human ratings are associated with activation in PPA and RSC. This finding supports the view that our algorithms only capture low-level features in images, and illustrates that higher-level information should be included in models to better match human ratings of perceived image complexity.

Acknowledgements: This work was supported by an NSERC Discovery Grant (#498390) and the Canadian Foundation for Innovation (#32896) to DBW.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 870

Distinct neural substrates for the perception and imagery of scenes

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Caroline Robertson[1] (cerw@dartmouth.edu), Adam Steel[1]; [1]Dartmouth

It is widely assumed that perception and mental imagery of high-level visual stimuli engage the same neural circuitry (O'Craven and Kanwisher, 2000). Here, using fMRI, we report surprising evidence to the contrary. First, participants (N=16) performed two localizers: 1) a place memory localizer (memory of places vs. people; Silson and Steel, 2019), and 2) a scene perception localizer (images of scenes vs. faces). At the individual level, these localizers revealed three regions of the brain -- one on each lateral, ventral, and medial surfaces -- that were selectively activated during memory of familiar places, which we refer to as the "place memory network" (PMN). These regions partially overlapped with, but were distinct from, the scene perception network (SPN), including the occipital, parahippocampal, and medial place areas (OPA, PPA, MPA). We subsequently compared brain activation in the place memory network vs. scene perception network while participants engaged in intermixed trials of a mental imagery vs. scene perception task. Surprisingly, we found that the SPN showed no activation during mental imagery. In fact, two scene regions (PPA and OPA) were significantly deactivated during mental imagery relative to baseline (OPA: $p<0.01$, PPA: $p<0.001$). In contrast, all PMN regions were strongly activated during mental imagery ($p<0.05$), while showing significantly less activity during scene perception than the SPN ($p<0.05$). A repeated-measures ANOVA revealed a significant interaction between Network (PMN vs. SPN) and Task (Imagery vs. Perception) (ANOVA: $p<0.001$). These results suggest that, for scenes, the neural substrates of imagery and perception are distinct: the PMN, rather than the SPN, supports mental imagery of scenes. Given the preferential selectivity of PMN for the memory - not perception - of visual scenes and adjacency to scene perception regions, we hypothesize that these regions may support mental imagery relevant to navigation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1413

Foveation induces Robustness to Scene Occlusion in Deep Neural Networks

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Arturo Deza[1] (arturo_deza@fas.harvard.edu), Talia Konkle[1]; [1]Harvard University

Humans sense visual information from the world with more spatial resolution at the center of gaze and progressively less spatial resolution in the periphery. Why? One explanation is that the number of retinal sensors is limited by biological constraints (e.g. related to the size of the optic nerve). However, it is also possible that spatially-varying samples of the visual world may confer a functional advantage for visual processing (e.g. robustness to occlusions). Here, we test this idea computationally using deep convolutional neural networks. We generated "foveated" versions of scene images, preserving the image resolution at the center of "gaze" and emulating progressive crowding in the periphery (Deza et al., 2019). Then, we trained an ensemble of models (n=5, AlexNet and ResNet18 architectures) to do 20-way scene categorization. One set of models was trained on foveated images, with varying points of fixation on the image—a form of natural augmentation by eye movements (Human-aug-nets). A second set of models was trained on full resolution images, with typical artificial augmentation procedures which crop, rescale, and randomly mirror the images (Machine-aug-nets). Finally, we assessed each model's robustness to 4 types of occlusion: vertical, horizontal, glaucoma, scotoma. We found that all networks had similar ability to classify scenes after training. However, Human-aug-nets were additionally robust to all forms of occlusion relative to Machine-aug-nets. Intriguingly, we found that Human-aug-nets were by far more robust to scotomal type of occlusion (foveal information removed) than machine augmented networks. These findings suggest that the local texture statistics captured in peripheral visual computations may be important for robustly encoding scene category information. Broadly, these results provide computational support for the idea that the foveated nature of the human visual system confers a functional advantage for scene representation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

An updated version of this work has been submitted to NeurIPS (Neural Information Processing Systems) 2020. Link to pre-print:
ABS: https://arxiv.org/abs/2006.07991
PDF: https://arxiv.org/pdf/2006.07991.pdf
Poster walkthrough: https://www.youtube.com/watch?v=irRChCG9h_4
For questions email me at : deza [at] mit.edu
*** Link to Poster *** (the link above does not work): http://arturodeza.wdfiles.com/local--files/home/Poster_Slide_Final_VSS.pdf

Abstract ID: 442

GANalyze: Toward visual definitions of cognitive image properties

Talk Presentation - *Topic area: Scene Perception: Models and mechanisms*

Lore* Goetschalckx[1,2] (lore.goetschalckx@kuleuven.be), Alex* Andonian[1], Aude Oliva[1], Phillip Isola[1]; [1]MIT (CSAIL), [2]KU Leuven

We introduce a framework that uses Generative Adversarial Networks (GANs) to study cognitive image properties (e.g., memorability, aesthetics, valence). Often, we do not have concrete visual definitions of what these properties entail. Starting from input noise, GANs generate a manifold of natural-looking images with fine-grained differences in their visual attributes. By navigating this manifold, we can visualize what it looks like for a particular GAN-image to become more (less) memorable. Specifically, we trained a Transformer module to learn along which direction to move a BigGAN-image's corresponding noise vector in order to increase (or decrease) its memorability. Memorability was assessed by an off-the-shelf Assessor (MemNet). After training, we generated a test set of 1.5K "seed images", each with four "clone images": two modified to be more memorable (one and two "steps" forward along the learned direction) and two to be less memorable (one and two steps backward; examples in Supplemental). The assessed memorability significantly increased when stepping along the learned direction ($\beta = 0.68$, $p < 0.001$), suggesting training was successful. Through a behavioral repeat-detection memory experiment, we verified that our method's manipulations indeed causally affect human memory performance ($\beta = 1.92$, $p < 0.001$). The seeds and their clones (i.e., "visual definitions") surfaced candidate image properties (e.g., "object size", "colorfulness") that may underlie memorability and were previously overlooked. These candidates correlated with the learned memorability direction. We furthermore demonstrate that stepping along a learned "object size" direction indeed increases human memorability, though less strongly ($\beta = 0.11$, $p < 0.001$). This showcases how the individual, causal effects of a candidate can be studied further using the same framework. Finally, we find that by substituting the Assessor, our framework can also provide visual definitions for aesthetics ($\beta = 0.72$, $p < 0.001$) and emotional valence ($\beta = 0.44$, $p < 0.001$).

Acknowledgements: This work was partly funded by NSF award 1532591 in Neural and Cognitive Systems (to A.O), by a fellowship (Grant 1108116N) and a travel grant (Grant V4.085.18N) awarded to Lore Goetschalckx by the Research Foundation - Flanders (FWO).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

For a copy of the full ICCV paper:
http://openaccess.thecvf.com/content_ICCV_2019/papers/Goetschalckx_GANalyze_Toward_Visual_Definitions_of_Cognitive_Image_Properties_ICCV_2019_paper.pdf

The GANalyze project page:
http://ganalyze.csail.mit.edu/

Abstract ID: 297

How do objects within a scene affect neural representation?

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Tess C. Durham[1] (tdurham1@fordham.edu), Elissa M. Aminoff[1]; [1]Fordham University

Previous studies have found brain regions to be associated with high-level visual processing. Amongst these, the lateral occipital complex is sensitive to object processing, the parahippocampal place area (PPA), retrosplenial complex (RSC), and the occipital place area (OPA) are sensitive to scene processing such as content and scene categorization. Most research on object modulation in scene processing has focused on computer-generated stimuli with controlled properties. The purpose of this study is to understand to what extent object differentiation in complex, real-world scenes is reflected in the activation patterns of these regions of interest (ROIs). This study utilized data from BOLD5000, an fMRI dataset consisting of 5,000 real-world scene stimuli (Chang et al., 2019). We categorized the images into 24 scene categories that had at least 35 different exemplars (M=57.6). The current analysis included nine outdoor categories and analyzed their object agreement across exemplars. Each image was thoroughly labeled by a consensus of human analyzers to yield an object-scene category matrix. Each matrix was cross-correlated to produce a similarity space defined by object presence. To address how object differentiation affects representation in these ROIs, a representational similarity analysis was performed comparing the similarity matrix defined by objects with a similarity matrix defined by the fMRI response within a given ROI. The results demonstrate a significant main effect of hemisphere across all ROIs, with higher similarity in the right. This was particularly significant within the OPA and trended in the RSC. We plan to incorporate the remaining 15 categories into the current analysis. These results suggest the right hemisphere in general, and in the OPA in specific, is involved in representing objects, at least when observed within real-world scenes. This work proposes a new framework for understanding how category selective regions process the content of scenes.

Acknowledgements: Fordham University Summer Undergraduate Research Program, Fordham University, NSF #1439237

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 306

Local and global symmetry affect brain activity to scenes in different ways

Talk Presentation - *Topic area: Scene Perception: Models and mechanisms*

John Wilder[1], Morteza Rezanejad[2], Sven Dickinson[1,3], Kaleem Sidiqqi[2], Dirk B. Walther[1,3]; [1]University of Toronto, [2]McGill University, [3]Samsung Artificial Intelligence Center Toronto

Local symmetry, measured via the medial axis, has been shown to influence behavior on visual tasks, from the detection of objects in noise, the classification of objects, up to the classification of scenes. Electrophysiological and fMRI studies have suggested various visual brain areas that might encode local medial symmetry. Information about the medial axis impacts the neural representation of objects as early as V3. Neurons in V4 are selective for specific locally symmetric shape parts. The local symmetry of a scene is encoded in the visual representations of PPA. Here, we wish to shed further light on where in the visual pathway local symmetry is represented for natural stimuli. We used the Bold5000 dataset, which contains 5000 images along with BOLD responses to each of those images for 4 participants. We algorithmically scored the local symmetry content of each image from the dataset. We regressed the mean local symmetry score of each image, the mean luminance, and the contrast against the BOLD activity. Whereas luminance and contrast affect activity in early to mid-level visual areas (V1-V4), local symmetry influenced neural activity in mid to high-level areas (V4, LOC, PPA, and RSC). As most of the previous work investigating symmetry in fMRI focused on global symmetry on dot patterns, we wanted to look at the effect of global symmetry on real-world scenes. To this end, participants on MTurk rated the amount of global symmetry in each image. We regressed their ratings to the BOLD responses from BOLD5000. Similar to local symmetry scores, the participant ratings influenced activity in LOC, suggesting that this area might represent both global and local symmetry. Unlike local symmetry, global symmetry did not significantly influence PPA activity. Our data shows, for the first time, that local and global symmetry differentially influence neural responses to real-world scenes.

Acknowledgements: This work was supported by an NSERC Discovery Grant (#498390) and the Canadian Foundation for Innovation (#32896) to DBW.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 936

Neural representation of the visual environment along the continuum from objects to scenes

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Jeongho Park[1] (jpark3@g.harvard.edu), Emilie Josephs[1], Talia Konkle[1]; [1]Harvard University

The visual system has distinctive networks supporting scene processing and object processing. However, in typical experience we perceive a continuum of views between these extremes. How do visual brain responses change as a function of the depicted scale of the space in view? To investigate this question, we created 20 indoor environments (e.g. kitchen, library) using virtual-reality software. All environments had the same physical dimensions, with an extended surface along the back wall (e.g. countertop, desk) containing both central and surrounding objects. For each environment, a series of 15 snapshots were rendered to smoothly sample between a close-up view of the central object on this surface, and far-scale view of the full environment, using logarithmically spaced steps. Brain responses were measured to each position along the continuum using functional magnetic resonance imaging in 12 participants. Within independently-localized scene and object regions, we found evidence for parametric responses: activation smoothly changed as a function of the spatial scale of the depicted view. In a whole-brain analysis, we found mixed evidence for a smoothly mapped continuum across the cortex—some participants showed intermediate regions with preferences to intermediate spatial scales, while others did not. Interestingly, this was in contrast to our localizer runs, where photographs of intermediate-scale spaces consistently activated some regions more than both object and full-scale scene views; however these regions were equally activated by all locations along the object-scene continuum in rendered images. The most consistent finding is that all participants showed extensive cortical territory along the ventral visual stream with either a monotonic increase or decrease in activation when the depicted scale of space is parametrically varied from objects to scenes. More work is needed to understand the individual differences in the mapping of this continuum onto the cortex.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 423

P2: A novel ERP marker of global scene perception

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Assaf Harel[1] (assaf.harel@wright.edu); [1]Wright State University

Humans are extremely adept at recognizing complex visual scenes, an ability supported by a network of dedicated scene-selective cortical areas. In spite of the growing knowledge of these areas, much less is known about the temporal dynamics underlying scene recognition. Since scenes vary on multiple dimensions, ranging from low-level image-statistics to high-level semantics and action affordances, the key question is which types of information get utilized at which timepoint. Our goal, therefore, in the current work is to identify the earliest electrophysiological markers of scene perception, and establish the scene properties they are most sensitive to. We report a series of ERP experiments demonstrating that the first signature of scene-selectivity (greater activity to scenes compared with faces and objects) occurs at posterior-lateral sites, at the P2 time window, 220ms post-stimulus onset. We demonstrate that functionally, the P2 indexes the processing of high-level global scene information: First, P2 is the only visually-evoked component to be modulated by scene inversion, as would be expected if global information is extracted during this period. Second, P2 amplitude is sensitive to global scene properties (GSPs), such as spatial expanse (closed/open) and naturalness (manmade/natural), and these effects are evident across a variety of stimulus presentation conditions and scene types. Moreover, P2 response to GSPs is largely unperturbed by manipulations of local texture information (in contrast to earlier visually-evoked components). Fourth, P2 is the first component to carry significant information about the potential for navigation in a scene (navigability affordances). Lastly, P2 responses to GSPs are hardly modulated by observers' recognition goals, suggesting rapid and mandatory processing of global scene information. Together, our findings suggest that global scene information is processed robustly and automatically around 220 milliseconds and that P2 can be used as an index of global scene perception

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thanks for checking out our poster! You can find some of the works described in the poster here: https://scholar.google.com/citations?user=3rokIVwAAAAJ&hl=en
Also, feel free to reach out and email me any questions that you may have: assaf.harel@wright.edu

Abstract ID: 908

Precise identification of semantic representations in the human brain

Talk Presentation - *Topic area: Scene Perception: Models and mechanisms*

Ian Charest[1,2] (i.charest@bham.ac.uk), Emily Allen[3], Yihan Wu[3], Thomas Naselaris[4], Kendrick Kay[3]; [1]School of Psychology, University of Birmingham, UK, [2]Centre for Human Brain Health, University of Birmingham, UK, [3]Center for Magnetic Resonance Research (CMRR), Department of Radiology, University of Minnesota, USA, [4]Neurosciences Department, Medical University of South Carolina, USA

Previous studies investigating semantic representations in the human brain present conflicting results regarding the localisation of such representations and whether they are distributed or modular. This is possibly due to the limited sensitivity and/or limited stimulus samplings of past experiments. We conducted a large-scale, high-field fMRI experiment (7T, whole-brain, gradient-echo EPI, 1.8 mm, 1.6 s) in which 8 subjects each viewed 9,000–10,000 colour natural scenes (taken from Microsoft COCO) while fixating and performing a continuous recognition task. We exploited this unprecedented dataset, termed the Natural Scenes Dataset (NSD), to investigate semantic representations in the brain using representational similarity analysis (RSA). Capitalising on the large array of naturalistic scenes, we obtained human-derived semantic labelings (sentence descriptions) from COCO and applied smooth inverse frequency sentence embeddings to construct semantic representational dissimilarity matrices (RDMs). We then used searchlight-based RSA in NSD to identify brain regions whose representation closely matches the semantic RDM. Significance was assessed using permutation testing. In each subject, we measured highly significant and reliable (t-values reaching 88) semantic representations in a highly distributed network including the ventral visual stream, the angular gyrus and temporoparietal junction, the medial and anterior temporal lobes (anterior hippocampus, perirhinal cortex), and the inferior frontal gyrus. In a separate analysis, we constructed RDMs based on a recurrent convolutional neural network (RCNN) model of object recognition and found that these RDMs mapped to a strikingly similar network of brain regions, albeit with weaker correlations. The immense scale of NSD allows precise quantification of semantic representations in individual subjects across the entire human brain. The promising performance levels achieved by the RCNN indicates that the NSD dataset can support further detailed investigations of the types of semantic brain representations that can and cannot be captured by current computational models of visual scene interpretation.

Acknowledgements: ERC-StG 759432, NSF IIS-1822683, NIH P41 EB027061, NIH P30 NS076408, NIH S10 RR026783, W. M. Keck Foundation.

This talk will be presented in Live Talk Session 7, Tuesday, 23 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 539

Representing navigational affordance based on high-level knowledge of scenes

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Byunghoon Choi[1] (2014182021@yonsei.ac.kr), Michael McCloskey[2], Soojin Park[1]; [1]Yonsei University, [2]Johns Hopkins University

When navigating in everyday life, the visual system constantly needs to estimate which way to move forward. Navigation processes might use visual scene properties as paths, walls, or high-level knowledge such as memory about locked/-unlocked status of a door. Recent studies suggested that a scene-selective Occipital Place Area (OPA) represents navigational affordances of a scene such as the direction of paths or the distance to boundary. What levels of navigational affordance information does OPA represent? Here we used fMRI to test whether OPA can use high-level knowledge cues, such as colored signs with learned meanings, to represent the navigational affordance of an environment. We constructed views of artificial rooms with one possible exit, on the left or right. In the low-level cue condition, the room had an exit on one side and a wall on the other side. In the high-level cue condition, the room had a door on both sides, with a small colored sign above each door to indicate which was unlocked (e.g., blue = unlocked, yellow = locked). Colors indicating locked vs. unlocked status counterbalanced across participants. Using a two-way SVM classification, we asked if multi-voxel patterns of scene-selective regions could represent path direction based on low- or high-level navigational cues (N = 14). First, we found significantly above-chance classification accuracy for path direction based on low-level cues in the OPA, but not in other scene-selective regions, consistent with previous suggestions for a specialized role of OPA in navigational affordance computation. Crucially, we also found significantly above-chance classification accuracy based on high-level color signs in the OPA. This result provides the first direct evidence that OPA can actively utilize high-level knowledge to compute navigational affordances of scenes, representing navigationally-relevant information that cannot be computed from the visual properties of the scene alone.

Acknowledgements: This work was supported by National Eye Institute (NEI) grant (R01EY026042) to MM and SP, National Research Foundation of Korea (NRF) grant (funded by MSIP-2019028919) and Yonsei University Future-leading Research Initiative (2018-22-0184) to SP.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 646

Roles of parahippocampal cortex and retrosplenial cortex in scene integration

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Olivia S. Cheung[1] (olivia.cheung@nyu.edu), Seoyoung Lee[1]; [1]New York University Abu Dhabi

Humans perceive a coherent visual world across time and space. To update incoming sensory information while maintaining a stable representation of the environment, it may be critical to utilize spatial-temporal continuation and/or shared local elements across views. Previous studies have suggested different roles of the parahippocampal place area (PPA) and the retrosphenial cortex (RSC) in scene processing, and the engagement of the PPA in ensemble processing. Using fMRI, we examined how the PPA and the RSC might integrate information by relying on continuous spatial-temporal sequence of information flow, or mere shared elements in a scene. We used scene images that were divided into three segments, with 66% overlap between the first and second segments and 33% overlap between the first and the third segments (Park & Chun, 2009). Across four conditions, participants (N=20) viewed identical segments for three times, three completely different scenes, or three segments of a scene either in sequential or displaced orders. We found that bilateral PPA not only showed significantly stronger activations for different than identical scenes (p's<.0001), but also for different scenes than three segments of the same scenes (p's<.005). For bilateral RSC, similar response amplitudes were observed for different scenes and three segments of the same scenes (p's=.087-.57), which were stronger than that for identical scenes (p's<.001). More importantly, using univariate and multivariate analyses, the sequence order of the three segments did not affect the response amplitude in either the PPA or the RSC (p's>.52), nor reveal above-chance decoding accuracy in both regions (p's>.86). The results suggest that the PPA, but not the RSC, distinguishes between same vs. different environments, despite differences across views of the same scene. Although the PPA may not be sensitive to the sequence of information flow, it appears to integrate segments with shared elements to form a coherent representation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
21 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Welcome to our poster! Feel free to reach out if you have any comments or questions:
olivia.cheung@nyu.edu

-Olivia & Seoyoung

Abstract ID: 532

Simulation-based solutions for power analyses for mixed models considering by-subject and by-item variability

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Leah Kumle[1], Melissa L.-H. Võ[1], Dejan Draschkow[2]; [1]Department of Psychology, Scene Grammar Lab, Goethe University Frankfurt, [2]Department of Psychiatry, Oxford Centre for Human Brain Activity, Wellcome Centre for Integrative Neuroimaging, University of Oxford

Power and precision in confirmatory analyses is a cornerstone for the reliability and replicability of empirical findings. Albeit important, calculating power is not necessarily a trivial task, and may pose a feasibility barrier to scientists. One of these cases is power analysis for linear and generalized linear mixed-effect models (LMMs, GLMMs), a popular and widely used tool in experimental research, including scene perception and visual search. Mixed models are a powerful tool for modelling fixed and random effects simultaneously, but do not offer a general and feasible analytic solution to estimate the probability that a test correctly rejects the null hypothesis. Therefore, a simulation-based approach is necessary. Although a mixture of tools for conducting simulation-based power analyses for mixed-effect models are available, there is a lack of structure and guidance on how to appropriately use them in different scenarios. Therefore, we have developed an openly accessible R package to assist with conducting power analyses for G/LMMs. With this package, we provide code and resources for performing such simulation-based power analyses on openly accessible data sets from cognitive research to illustrate possible practical solutions to transparent sample size and design planning where the effect of adding different units (e.g. participants or trials) can be explored and justified. We also discuss common pitfalls and theoretical constraints that need to be considered when conducting a power analysis for LMMs/GLMMs. Our resources are tailored to

cognitive and vision scientists and aim at empowering researchers to set up highly powered research designs when sophisticated analysis procedures like G/LMMs are outlined as inferential procedures.

Acknowledgements: This work was supported by DFG grant VO 1683/2-1 to MLV and Wikiversity (https://de.wikiversity.org/wiki/Wikiversity:Fellow-Programm_Freies_Wissen).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

Link to a more in-depth tutorial paper: https://psyarxiv.com/vxfbh

Link to R-Notebooks mentioned in the poster: https://lkumle.github.io/power_notebooks/

Feel free to also contact me at leahkumle@gmail.com and I look forward to talking to you in one of the scheduled conferences.

Abstract ID: 696

Spatiotemporal Dynamics of task-related Scene Processing

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Jeffrey Nador[1] (jeff.nador@wright.edu), Andrew Persichetti[2], Assaf Harel[1]; [1]Wright State University, [2]National Institutes of Health

Humans can extract visual information from complex scene images in as little as 17ms, and use it to interact within their environments, for instance by navigating through a scene (e.g. “I can go left”), or categorizing it (e.g. “this is a kitchen”) within 220 ms. fMRI studies have demonstrated that the cognitive processes underlying these tasks are supported by distinct neural systems: navigation is supported by the occipital place area; categorization is supported further downstream in the ventral visual pathway, by the parahippocampal place area. Taken together, these results imply that a complete account of task-based influences in information extraction from visual scenes requires considering both spatial (where in the brain) and temporal (when during processing) aspects of the interaction between the task being performed, and the task-relevant information in the visual scene. To that end, we recorded 20 participants’ EEGs while they completed 3 behaviorally matched tasks (navigation, categorization, and one-back repetition) on the same set of scene stimuli that were counterbalanced across categories (bedrooms,

kitchens, living rooms) and navigable paths (left, center, right). In order to analyze the task-by-category-by-path interaction over time without losing spatial information, we developed a novel "with-or-without-you" representational similarity analysis (WOWY-RSA), and applied it to the ERP data. This allowed us to predict not only the time-course of the interaction, but also which electrodes contributed significant amounts of task-, category-, and path-relevant information to the overall RSA, thus preserving the EEG's coarse spatial information. WOWY RSA revealed significant early decoding of these three sources of information at lateral central and central posterior electrode sites around 100ms after stimulus onset, and later decoding at fronto-central and lateral central electrode sites from 370-550ms. Overall, our results agree with the hypothesis that information extraction from visual scenes is task dependent, implicating spatiotemporally distinct neural mechanisms.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1575

The Natural Scenes Dataset (NSD): A yearlong ultra-high field whole-brain human fMRI visual perception and memory study

Talk Presentation - *Topic area: Scene Perception: Models and mechanisms*

Emily J. Allen[1] (prac0010@umn.edu), Yihan Wu[1], J. Benjamin Hutchinson[2], Thomas Naselaris[3], Kendrick N. Kay[1]; [1]University of Minnesota, [2]University of Oregon, [3]Medical University of South Carolina

Developing accurate, generalizable models of visual representation requires extensive stimulus sampling due to the vast dimensionality of visual inputs. The aim of this study was to design, collect, and pre-process a massive, high-quality fMRI dataset that can be used to advance our understanding of visual representation in the human brain. Using ultra-high-field fMRI (7T, whole-brain, T2*-weighted gradient-echo EPI, 1.8-mm resolution, 1.6-s TR), we measured BOLD responses while each of 8 participants viewed 9,000–10,000 distinct, color natural scenes (22,500–30,000 trials) in 30–40 weekly scan sessions over the course of a year. As participants fixated a central point, they performed a long-term continuous recognition task in which they judged whether they had seen each image at any time during the experiment, either in the current scan session or any previous scan session. Data collection is now complete and includes functional data during the continuous recognition task, as well as resting-state data, retinotopy, category localizers, anatomical data (T1, T2, diffusion, venogram, angiogram), physiological data (pulse, respiration),

eye-tracking data, and additional behavioral assessments outside the scanner. Pre-processing and data quality assessments indicate that the data are of exceptional quality, with participants having nearly perfect response rates, high task performance, and low head motion, and with brain images having high contrast-to-noise ratio and spatial stability across scan sessions. Both the raw and pre-processed data will be made publicly available to the scientific community. Because of its unprecedented scale and richness, NSD (http://naturalscenesdataset.org) can be used to explore diverse neuroscientific questions with high power at the level of individual subjects and to develop models of the complex series of transformations occurring throughout the visual hierarchy.

Acknowledgements: NSF IIS-1822683, NIH P41 EB027061, NIH P30 NS076408, NIH S10 OD017974-01, NIH S10 RR026783, W. M. Keck Foundation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 589

The place memory network: A network of brain areas supporting perception and memory of familiar places.

Talk Presentation - *Topic area: Scene Perception: Models and mechanisms*

Adam Steel[1] (adamdanielsteel@gmail.com), Madeleine Billings[1], Caroline Robertson[1]; [1]Dartmouth College

Successful navigation requires integrating the current field-of-view with your memory of the surrounding environment. However, the neural circuitry mediating the interaction between perception and memory for scenes is not well understood. Here, we investigated the interaction between place memory and scene perception using fMRI. In Experiment 1, we identified the “place memory network”, a set of brain areas selectively engaged when participants (n=16) performed mental imagery of familiar places (versus people). In each participant, these regions overlapped with, but were distinct from, the perceptual scene network (including the parahippocampal place area, occipital place area, and medial place area). The place memory regions typically deactivate during visual presentation of unfamiliar scenes, suggesting that these regions are not visually responsive. However, in Experiment 2, we found that the place memory network responds to visual scenes if the image is of a personally familiar place. Specifically, we showed participants panning movies that included personally familiar places and unfamiliar places (e.g. your house versus an unfamiliar

house) and examined activation of the place memory and scene perception networks. Regions of the place memory network showed a strong preference for familiar compared to unfamiliar places ($p<0.001$) above and beyond regions of the perceptual scene network (Interaction: $p<001$). These results show that the place memory network responds to visual stimulation if spatial context is known and suggest a role for these areas in processing familiar environments. Finally, we examined the functional relationships between the scene perception and place memory networks by evaluating functional connectivity during movie watching. We found that, despite their spatial discontinuity, the regions of the place memory network were strongly connected relative to their connection with the scene perception network. These data suggest that the place memory network may play a role in perception by representing the remembered environment.

This talk will be presented in Live Talk Session 7, Tuesday, 23 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for coming to my presentation! Check out our preprint on bioRxiv:
https://www.biorxiv.org/content/10.1101/2020.05.25.115147v2

In the event of technical problems, you can find the video on YouTube: https://youtu.be/jsCiRmLi3zw.

If you have any questions, please stop by my scheduled session or email me at:
adamdanielsteel@gmail.com

Abstract ID: 1391

Uncovering a scene-defining feature using converging stimuli-based, behavioral and neural approaches

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Annie Cheng[1], Daniel Dilks[2]; [1]Emory University

Humans are incredibly good and fast at recognizing places, or “scenes”. Not surprisingly then, there are cortical processes specialized for scene recognition; however, it remains unknown how humans recognize scenes from non-scene stimuli, such as faces and objects. Here, we hypothesize that, just like faces always have two eyes above a nose, above a mouth, there also exists some scene-defining visual features that enable the human brain to recognize scenes. To identify a potential scene-defining feature, we analyzed

thousands of highly variable naturalistic scene images and found that, across most scenes, there is a vertical asymmetry in luminance, with the upper half brighter than the lower half. Next, we asked if this vertical luminance asymmetry (VLA) is not only a common scene feature, but also necessary to engage human visual scene processing. We predicted that if VLA is indeed necessary to engage scene processing, then a 90-degree image rotation that disrupts the VLA of a scene will impair scene recognition. Consistent with our hypothesis, we found people are worse at recognizing scenes that are rotated away from their upright, canonical orientations (90-degree, 180-degree, 270-degree rotation), while object recognition is unaffected by image rotation. Similarly, using functional magnetic resonance(fMRI), we found that the cortical scene processing system shows a diminished response to rotated scene images, whereas the cortical object processing system does not differentiate objects across different orientations. Taken together, these results provide converging stimuli-based, behavioral, and neural evidence that VLA is a scene-defining feature that enables the human brain to differentiate scenes from non-scene stimuli.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 195

Ventral temporal neurodynamics captured with electrocorticography during free-viewing of natural scenes

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Matthew J. Boring[1] (mjb200@pitt.edu), R. Mark Richardson[2], Avniel Singh Ghuman[1]; [1]University of Pittsburgh, [2]Massachusetts General Hospital

Response properties of regions in ventral temporal cortex (VTC) have often been characterized during highly controlled experimental paradigms where an unpredictable sequence of single, isolated objects are presented for a few hundred milliseconds to passively fixating participants. The visual environment of the real world is relatively stable and predictable, containing contextual information that grounds objects in their environment, which is actively and volitionally sampled during free-viewing. The degree to which these differences between experimental versus naturalistic viewing conditions are reflected in the neurodynamics of VTC regions remains unclear. To compare these responses, we presented natural scenes to one pilot patient with intractable epilepsy during a free-viewing paradigm while collecting electrocorticography (ECoG) from VTC and eye tracking data. The VTC neurodynamics collected during free-viewing of natural scenes was compared to the responses evoked by similar objects presented in a more

traditional experimental paradigm. VTC data could be used to reliably predict when the subject was looking at a face or not during free-viewing. Furthermore, above-chance decoding occurred as early as 200 ms prior to saccades landing on a face. This suggests that face-processing occurs in VTC even prior to fixating faces in natural scenes. Classifiers trained to discriminate face from non-face trials in the traditional paradigm could reliably discriminate face from non-face fixations in the free-viewing task. This suggests that neural responses during the traditional experimental paradigm shared some similarity to those evoked during free-viewing paradigm. However, responses evoked by face fixations in the free-viewing task were stronger in the high gamma frequencies (40-200 Hz) and less pronounced in lower frequency ranges compared to those evoked by the traditional paradigm. Future work is necessary to investigate how image characteristics, such as scene context, contribute to pre-saccadic activation of object-selective VTC and whether these results generalize to larger patient populations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Supplementary information can be found here: https://docs.google.com/document/d/1pHsq-8CNEh1rueemDaaPPWNiJmVQDQSMBsa6kxtb8Ho/edit?usp=sharing

Abstract ID: 576

Weighing the contribution of object identity vs configuration information in convolutional neural network scene representation

Poster Presentation - *Topic area: Scene Perception: Models and mechanisms*

Kevin Tang[1] (k.tang@yale.edu), Marvin Chun[1], Yaoda Xu[1]; [1]Yale University

Visual perception involves extracting the specific identities of the objects comprising the scene in conjunction with their configuration (spatial layout of objects). How a visual information processing system weights these two types of information during scene processing, however, has never been examined. Convolutional neural networks (CNNs) are one class of visual information processing system, and recent developments have demonstrated their ability to accurately classify both object images and scene images. To understand the relative contribution of object identity and configuration information in CNN scene representation, we examined four CNN architectures (Alexnet, Resnet18, Resnet50, Densenet161) trained on either an object identification task or a scene recognition task. Each CNN was run on 20 sets of indoor scene images (e.g., a room with furniture). For each set, we created four images obtained by crossing two

object sets (e.g., different pieces of furniture) in two different configurations. For a given CNN layer, we obtained the activations for each image in a set and then calculated the relative strength of object identity and configuration representation by measuring (1) the Euclidean distance for two images sharing the same configuration but different objects and (2) the Euclidean distance for two images sharing the same objects but different configurations. Object identity dominance is then measured as [(1)-(2)]/[(1)+(2)], with a value of 1 indicating an object-dependent representation that disregards their configuration, and -1 indicating a configuration-dependent representation that disregards the objects in it. All the CNNs revealed a statistically significant ($p < .05$) preference for configuration representations in early layers. In later layers, however, object representations dominated ($p < .05$). The same results hold regardless of whether a CNN was trained in the object or scene recognition task. These results provide significant insights regarding how object identity and configuration may contribute to scene representation in a CNN.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 933

Scene Perception: Natural image statistics, spatiotemporal factors

Building the “Reachspace Database”: a large-scale stimulus set of reachable environments

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Emilie Josephs[1] (emilie.josephs.1@gmail.com), Haoyun Zhao[1], Talia Konkle[1]; [1]Harvard University

Much of human behavior takes place in the near space: whether for work or for leisure, we spend our days acting upon the reachable environment, using our hands to manipulate objects in the service of a task—typing an email, chopping vegetables, or pouring a cup of coffee. While classic frameworks in vision do not draw sharp distinctions between reachable-scale and navigable-scale scenes, we have found that views of these reachspaces dissociate from navigable-scale scenes in both perceptual and neural measures (Josephs & Konkle, 2019; Josephs & Konkle, VSS, 2019). Here, we introduce a large-scale database of reachspace images, in order to facilitate research into the perception of reachable environments. To sample

reachspaces, we compiled a list of hobbies, chores, and professions, and used online searches to find images of the reachable environments people view when engaged in those activities. We additionally considered common locations, generated lists of activities performed in those spaces, and collected the corresponding images. We restricted images to have an appropriate perspective, angle, and distance, reflecting the view of a person performing a task in that space. This process has identified 175 reachspace categories each with 20 or more images per category (N= 4,267 images), with more categories continuously being added. The sampled categories endeavor to show broad cultural variability (i.e. Go boards as well as chessboards), represent a broad sampling of occupations (i.e. sound mixers, office workers, carpenters), and include a broad sampling of activities in each location (i.e. kitchens can support chopping vegetables, washing dishes, decorating cakes, mixing ingredients, etc). Rich and high-quality image sets exist for objects and scenes, and here we introduce one for views of the space in between. Overall, this database will provide an important resource for researching visual cognitive processes operating over reachable views of the environment.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

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ACCESSIBILITY INFO
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There are no captions on the video, but you can find a full transcript here:
https://docs.google.com/document/d/1bLw6fU9i4hqoW71P1tquei3aciyXCJOBSi6VK3KJHHU/edit?usp=sharing

Abstract ID: 193

Causality and continuity close the gaps in event representation

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Jonathan F. Kominsky[1] (jonathan.f.kominsky@gmail.com), Lewis Baker[2], Frank C. Keil[3], Brent Strickland[4]; [1]Rutgers University - Newark, [2]Pymetrics, Inc., [3]Yale University, [4]Institut Jean Nicod, Ecole Normale Superieure

Imagine you see a video of someone pulling back their leg to kick a soccer ball, and then a soccer ball soaring towards a goal. You would likely infer that these scenes are two parts of the same event, and this inference would likely cause you to remember having seen the moment the person kicked the soccer ball,

even if that information was never actually presented (Strickland & Keil, 2011). We tested whether the spontaneous formation of coherent event representations relies on semantic implication, or a more automatic object-tracking system. In Experiment 1 (N=90), participants were more likely to falsely reported seeing the moment of contact/release in unfamiliar computer-generated animations of novel launching or launching-by-expulsion events (M=68.3%, SD=27.0) than in animations in which the second half of the event was an unrelated “non-sequitur” outcome (M=31.7%, SD=31.4), p<.001. Experiment 2 (N=120) independently manipulated whether the object’s trajectory was visible following the cut, and whether there was an event that seemed to be caused by the object in the second half of the video. Results showed that visible object trajectory alone dictated the filling-in effect (visible: M=69.4%, SD=28.2; invisible: M=27.9%; SD=30.9), F(1,110)=55.29, p<.001, partial eta-sq=.334. Experiment 3 (N=200) used naturalistic videos, and independently manipulated whether the features of the object were changed at the cut (e.g., a dart becoming a balled-up piece of paper) and whether the cut placed the object “too far” along its trajectory, disrupting spatiotemporal continuity. We found that participants recognized that the feature change had occurred (77%), but nonetheless filled-in the moment of contact/release provided there was continuity (M=75.0%, SD=28.6), while continuity disruptions significantly diminished the filling-in effect (M=67.5%, SD=30.8), F(1,196)=6.21, p=.014, partial eta-sq=.031. Together, these findings indicate that the spontaneous formation of event representations is driven by object tracking systems that are primarily sensitive to spatiotemporal continuity.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

You can contact the first author at jonathan.kominsky@rutgers.edu.
The still images on the poster are hyperlinks to videos stored on OSF (NOTE: does not work in Adobe web viewer, you will have to download the PDF). The full OSF repository can be found here: https://osf.io/mjwkd/

Abstract ID: 247

Driving Hazard Detection on the Road Does Not Reveal the Prevalence Effect

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Christopher I. Hernandez[1,2] (c.hernandez@knights.ucf.edu), Dr. Katherine Rahill[1,2,4], Minh Pham[2], Lucho Manriquez[2], Priscilla Louis[2], Alexandra Figueroa[2], Bryan Medina[2], Dr. Benjamin Wolfe[3], Dr. Ben D. Sawyer[1,2,4]; [1]Industrial and Management Systems Engineering, University of Central Florida, [2]Laboratory for

Autonomy-brain Exchange (LabX), University of Central Florida, [3]Brain and Cognitive Sciences, Massachusetts Institute of Technology, [4]Institute for Simulation and Training, University of Central Florida

Previous work has shown that with an increase in the number of signals, accuracy in identifying them improves a phenomenon termed the prevalence effect. However, in complex tasks, particularly those in visually rich environments, prevalence effects may fail to appear. Detecting hazards on-road, a rich, real-world task, has been suggested to be affected by hazard prevalence. To assess whether prevalence effects do, in fact, occur in hazard detection, we performed a laboratory study using short video clips of road scenes with and without hazards. Fifteen observers were divided into three prevalence groups and performed 20 practice trials, followed by 300 experimental trials each. In each trial, participants were asked to either press the brake pedal if they perceived a hazard or press the accelerator pedal if no hazard was perceived. Hazard probabilities across three conditions were held at approximately 1%, 5%, and 20%. Accuracy in these conditions was, respectively, 60%, 64%, and 61%, revealing no effect of hazard prevalence on performance. This result suggests that avoiding hazards on the road may join other real-world contexts where prevalence effects do not occur. This is both of interest in terms of both understanding prevalence effects in real-world contexts, and in the application of prevalence effects in transportation. On the road, human vigilance in monitoring the roadway for hazards is a key component of new semiautonomous driving systems, and this finding points to the driver's ability to intervene when needed. We suggest that the lack of a prevalence effect in this study may be due to the rich environment in these video clips, or a task-specific effect related to driving or hazard detection.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1692

Frequency-tuned animal warning signals

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Julie Harris[1], Olivier Penacchio[1], John Skelhorn[2], Candy Rowe[2]; [1]University of St. Andrews, [2]Newcastle University

Animals warn off potential predators through conspicuous, distinctive colors and patterns, called visual warning signals. These visual patterns have well understood effects on predators: they deliver unlearnt wariness and enhanced memorability. But it is not clear what specific image characteristics of such patterns cause these behavioural effects. Here we tackle the question of if, and why, specific spatial frequencies are

pervasive in warning signals. We hypothesized that the dominant frequencies involved in animal warning signals may specifically stimulate predator visual systems at the typical distance at which they decide whether to attack or not. We first developed a database of hyperspectral images of Lepidoptera (butterfly and moth) wing patterns, from both species that utlise warning signal patterns and species that do not. We also built a generic mathematical model of the bird visual system, including model 'neurons' sensitive to different spatial orientations and spatial scales. We found that warning signals trigger a higher model activity, and do so maximally for a subpopulation of the model units sensitive to specific spatial frequencies. We found that at 8-12cm (the typical decision distance for some birds), the maximum model sensitivity corresponds to the peak of the bird contrast sensitivity function, namely 1 cpd. When viewing distance is taken into account, our findings show that patterns dominated by 1cpd spatial frequencies maximally stimulate a generic model of the early bird visual system. This suggests that such patterns might be specifically deterrent to birds predators Thus, some characteristics of animal warning signals may have evolved to deter predators at the distance where a decision is made.

Acknowledgements: Uk BBSRC

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

Welcome to the poster, we hope you enjoy learning about our work. Please join us on zoom if you have questions. Ask in the chat box and we'll try to get to everyone.

If you have questions and we're not online, please contact either of the first two authors on jh81@st-andrews.ac.uk, op5@st-andrews.ac.uk.

Abstract ID: 745

Nature in motion—the psychophysical tuning of the visual system to the fractal properties of natural scenes in both space and time

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Zoey Isherwood[1] (zoey.isherwood@gmail.com), Mark Schira[1], Michelle Roberts[1]; [1]School of Psychology, University of Wollongong

Despite the large variability that exists across nature (e.g. forests, deserts, mountains), natural scenes share many statistical properties. Firstly, they are similar in their photometric properties since they each contain a unique distribution of luminance intensities across spatial and temporal frequencies known as the $1/f\alpha$ amplitude spectrum ($\alpha \approx 1$). Secondly, natural scenes are similar in their geometric properties as they each contain a similar density of structure across spatial and temporal scales—a property which classifies them as fractal (e.g. how the branching pattern of rivers and trees are similar irrespective of scale). Recent research suggests that the visual system is preferentially tuned to natural geometry over photometry. However, so far research has been restricted to the spatial domain. It is currently unclear whether this tuning extends to the temporal domain (e.g. how waves roll into the shore). Here, we use a psychophysics task (4AFC) to measure discrimination sensitivity (N = 90) to synthetic noise movies that varied across three movie types—greyscale, thresholded, and edges. Each movie type shared the same geometric properties (measured using fractal D), but differed substantially in their photometric properties (measured α). We observe a characteristic dependency on geometry across movie types where sensitivity peaks for stimuli with natural geometry despite large differences in their photometric properties in both space and time. This preferential tuning may not be surprising given the stability of structure in natural scenes irrespective of scene illumination (e.g. the structural properties of a tree do not change whether it is morning or night despite large changes in illumination/photometric properties across the two time points). Whilst only measured here at the behavioural level, our findings may infer that the neural processes underlying this tuning may have evolved to be sensitive to the most stable signal in our natural environment—structure.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York
24 June, 2:00 am EDT America/New_York

Presenter's Message

View my poster here: https://bit.ly/2NeAW7G
View my walkthrough of the poster here: https://bit.ly/37HsTtm
Link to a high quality video of the stimuli: https://bit.ly/30YmFnB

Abstract ID: 1713

On the statistics of soothing natural scenes

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Elif Celikors[1] (ec839@cornell.edu), Nancy M Wells[1], David J Field[1]; [1]Cornell University

A relatively large literature in environmental psychology has been dedicated to the restorative effects of natural scenes, in which the term “restoration” refers to the improved cognitive functioning found in various tasks. The literature on the restorative effects of nature suggests a set of vaguely defined terms that are associated with restoration. Are there any quantifiable measures that these terms correspond to? The purpose of the current study is to examine the relationships between the low-level visual features and terms associated with restoration. Low-level features include statistics like edge density (ED), pixel entropy, saturation, and standard deviation of saturation. The definitions of the terms associated with restoration were adapted from the Perceived Restorativeness Scale. Through Amazon Mechanical Turk, 88 participants rated 680 outdoor images on naturalness and four restorative terms. We found 20 weak but significant correlations. The largest correlations were between naturalness and ED (r=.30), being-away and saturation (r=.25) and being-away and ED (.22). We also trained linear classifiers on low-level features to learn whether or not an image was rated high on each term. Classification accuracy was 72% for fascination, 83% for coherence, 79% for scope, 60% for being-away, and 61% for naturalness. The small correlations that we found suggest that low-level statistics can only weakly predict these terms. However, the above-chance success of the classifiers imply that a non-linear combination of these statistics might be predictive of the terms. We discuss these results in terms of the biases of the databases and question how representative the images are of our experiences with natural scenes.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Password for the zoom meeting: 525508

Abstract ID: 821

Quantifying orientation biases across the visual field in humans and cats

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Dominik Straub[1,2] (straub@psychologie.tu-darmstadt.de), Constantin A. Rothkopf[1,2]; [1]Institute of Psychology, TU Darmstadt, [2]Centre for Cognitive Science, TU Darmstadt

The efficient coding hypothesis posits that visual systems are adapted to the regularities they are exposed to. Many studies have measured the statistics of natural images and revealed biases in the distribution of orientations, such as a predominance of cardinal compared to oblique orientations as well as an increase of radial versus tangential orientations with increasing eccentricity. These phenomena have their correspondence both in psychophysics with the oblique and meridional effect, and in the

overrepresentations of corresponding orientations in V1. However, the commonly used natural image databases have a rather small field of view. To really quantify the statistics of the natural input to the visual system, a large field of view as well as the physical properties of the visual system should be taken into account. Here, images with a field of view of 120° were generated during exploration of a virtual forest environment from both human and cat perspective. Images were projected onto idealized retinas according to models of the eyes' geometrical optics. Image statistics across the visual field were examined using power spectra and sparse coding. For small eccentricities, the measured statistics matched those of photographic images. Confirming previous research, there was a bias towards cardinal orientations in both second-order and higher-order statistics. For larger eccentricities, we found an increasing bias towards radial orientations. In the images taken from the cat's viewpoint, differences between lower and upper visual field were more pronounced compared to the human viewpoint. This lays the groundwork for quantitatively relating natural image statistics across the visual field with neural representations of orientation and psychophysical behavior in orientation discrimination and confirms that the input to the visual system is influenced by the structure of the environment, but also the physical properties of the visual system and the observer's viewpoint.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1309

Rapid Ensemble Averaging of Orientation without Individual Item Encoding

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Jacob Zepp[1] (jacobzepp@mail.usf.edu), Chad Dubé[1], David Melcher[2]; [1]University of South Florida, [2]University of Trento

Human observers can accurately report summary statistics of features varying across stimuli within an ensemble. However, the literature on ensemble coding has yet to resolved a crucial question: Is it necessary to encode each individual item in visual short-term memory (VSTM), or can summaries be extracted earlier, during initial processing and iconic memory? To evaluate this distinction, participants performed an orientation averaging task on a display that consisted of 15 bisected circles presented across two 10ms presentations, with a variable ISI between. Participants then recreated what they believed to be the average of the 15 circles by rotating a probe circle. Although the stimulus presentation times were

within the parameters of iconic memory displays, and too brief for saccades to individual items, participants gave significantly precise reproductions of central tendency. We then compared the results of the averaging task to two item-specific tasks, temporal integration and segregation, conducted using the same stimuli and within the same experimental session. Results revealed that while the performance of the participants for the item-specific tasks was strongly dependent on the ISI, as previously reported, the averaging task was equally precise across the ISIs. These results suggest that central tendency information can be extracted rapidly in the absence of (and hence, prior to) the entry of items into STM. This ability to quickly process "the forest" rather than the individual "trees" may allow central tendency representations to be extracted regardless of whether individual item information is preserved in VSTM.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1355

Remembered environmental context facilitates distance perception in early stages of brief glimpses

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Prachi Mahableshwarkar[1] (pmahable@gwmail.gwu.edu), Lindsay Houck[1], John Philbeck[1]; [1]George Washington University

Although visual space perception research has historically focused on the role of on-line egocentric distance cues, recent work has shown that spatial information remembered from previous glimpses can facilitate processing of distance cues. Here we investigated whether the benefit of remembered spatial information might depend on the duration available for extraction of distance cues. Targets were rectangular orange boards subtending a constant angular size across distances varying between 2.5-7m. Viewing was binocular and targets were seen in a well-lit, largely empty room. A first block involved brief presentations of the target (70, 120, 170, or 220 ms, manipulated between groups of n = 15), followed by a visual mask. Distance was indicated by blindfolded walking. A 10 sec glimpse of the room without target was then provided, to establish a strong memory of the environment. A second block of brief glimpses was conducted to assess improvement after the long glimpse, followed by a third block with longer (5 sec) viewing durations as a measure of asymptotic performance. The groups were well-matched in their

asymptotic performance, with mean response versus distance slopes = 0.96. Only the 70 ms group showed a benefit of the longer glimpse between blocks 1 and 2 ($p = .039$), with mean response slopes increasing from 0.66 to 0.76 across blocks. Block comparisons for all other durations yielded ps > .16. This suggests that remembered spatial information, when available, is primarily used in the earliest stages of a glimpse.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1376

Spatial Frequency Filtering: Choices Matter

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Dirk B. Walther[1,2] (bernhardt-walther@psych.utoronto.ca), Sabrina Perfetto[1], John Wilder[1]; [1]University of Toronto, [2]Samsung Artificial Intelligence Center Toronto

Spatial frequency content is an important property of natural scenes and has been studied at length. To isolate the effects of specific spatial frequencies, images are typically filtered to include only a particular range of frequencies. The filtered images are then used in experimental tasks assessing observers' performance in scene content-related task. In addition to selecting the filtering frequency, several other choices that are made in the process of generating filtered images are likely to affect visual perception. We investigated three such choices: the shape of the frequency filter, contrast normalization, and contrast polarity of high spatial frequency-filtered images. We generated filtered images with different settings of these parameters and used them as stimuli in a speeded six-alternative forced-choice scene categorization task. We found that each of the choices strongly affected the categorization performance for low and high pass-filtered images, sometimes determining which of the two resulted in better performance. Filter shape needs to balance a clean frequency cut-off with minimizing ringing artifacts in the filtered image. We recommend using a second-order Butterworth filter as a reasonable compromise. Because of the power spectrum of natural images, filtering images without normalizing contrast severely hurts high pass-filtered images, making them hard to recognize simply due to a lack of contrast. We therefore recommend adjusting contrast energy to be the same for low and high-pass filtered images. High pass-filtered images can be depicted as white lines or black lines on a neutral background without affecting their spatial frequency content. We find that black lines are easier to recognize, presumably due to the cultural habit of drawing by making dark markings on a bright medium. To summarize, we find that several choices in the process of generating frequency-filtered images matter for visual perception. We have quantified these effects empirically and derived specific recommendations.

Acknowledgements: This work was supported by an NSERC Discovery Grant (#498390) and the Canadian Foundation for Innovation (#32896) to DBW.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thanks for stopping by our virtual poster board!

This work has been published as an open-access paper: https://doi.org/10.3390/vision4020029

Code and data are available at OSF: https://osf.io/gphra/

You can contact me by email at: bernhardt-walther@psych.utoronto.ca
And on Twitter: https://twitter.com/DirkBWalther

Abstract ID: 1205

The Interactive Effects of Scenes and Actions During Mental Model Construction

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Adam Larson[1] (larson@findlay.edu), Carrigan Milner[1], Bailey Rader[1], Dalton Shevlin[1]; [1]The University of Findlay

When we observe situations, in film or in real-life, we begin to build a mental model of the situation in working memory. The model encodes different semantic concepts like the situation’s scene (e.g., ‘Kitchen’) and people’s actions (e.g., ‘Cooking’). Our previous research showed that the time-course of mental model construction begins by recognizing the scene category followed by the action. This suggests that the previously stored scene content could facilitate future action recognition. The current study examines if the scene category can facilitate action categorization, and whether this facilitation is due to low-level scene information? Our experiment presented actions while the image background was manipulated to contain either the scene background, a gray background, or a texture background. The texture condition was created by generating a texture from each original scene image. Afterwards, the action was cropped from the original scene image and placed onto its corresponding texture. Critically, the low-level scene information was similar between the scene and texture background conditions while the two conditions

differed in scene category recognizability. Texture masks were also used to manipulate the image processing time from 24 - 660 ms SOA. After the mask, an action category post-cue was presented and participants made a Yes/No response to the validity of the cue. The results showed that action sensitivity was greater for the gray background condition than the scene background at 24 ms. Conversely, at 330 ms this effect reversed, indicating an interference effect during the earliest stage of mental model construction and facilitation at a later stage. Furthermore, our data show that action sensitivity was greater for the scene background condition than the texture background, indicating that the facilitation effect was not due to low-level scene information contained in the texture. Instead, action facilitation may be due to recognizing the scene.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1672

Understanding dynamic scenes: How driving can teach us about scene perception

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Benjamin Wolfe[1] (bwolfe.global@gmail.com), Ruth Rosenholtz[1]; [1]Massachusetts Institute of Technology

Scene perception in daily life requires understanding dynamic natural scenes as we interact with and move through them. Given that our environment continues to change while we process the information from the previous moment, how can we keep up? To probe this perceptual question, we have used a driving paradigm, since it combines natural stimuli and navigational tasks with the need for rapid responses. We have previously shown that observers can report localized, task-relevant changes in a dynamic road scene using only peripheral vision, detect emergent hazards from video clips as short as 220 ms, and understand the environment well enough to evade a potential crash after only watching a 403 ms video. Here, we expand that research to examine more of the information gathering process, asking where observers look, particularly under time pressure. To enable this, we extended the freely-available Road Hazard Stimuli dataset to include spatial annotations of hazardous objects. This allows us to determine when (and if) observers initially look at the hazardous objects in these dynamic scenes. In an experiment examining where observers look when returning their gaze to the road, we find that their first saccade is rarely to the hazardous object, but they show a benefit (in duration threshold) of making this saccade even when it is poorly targeted relative to the hazard (mean duration threshold; 594 ms when saccading vs. 754 ms for

peripheral-only, n=6). These results not only inform our understanding of eye movements in dynamic natural scenes, but also models of how observers gather information across the field of view. Scene perception in dynamic scenes involves more than where the observer looks; improving information acquisition by better leveraging peripheral vision facilitates scene understanding.

Acknowledgements: This work was supported by the Toyota-CSAIL Joint Research Center at MIT.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Starting in January 2021, I'll be an Assistant Professor in Psychology at the University of Toronto Mississauga and I'm recruiting graduate students to start in Fall, 2021. If you know students who are interested in applied or translational questions in vision (not just driving!), please put them in touch: bwolfe@mit.edu.

Abstract ID: 145

Visual consequences of the luminance transients from eye blinks

Poster Presentation - *Topic area: Scene Perception: Natural image statistics, spatiotemporal factors*

Bin Yang[1] (yangbin1004@gmail.com), Janis Intoy[1,2], Michele Rucci[1]; [1]University of Rochester, [2]Boston University

Eye blinks are commonly assumed to be detrimental for visual functions, as they momentarily block the input to the retina. However, they also modulate strongly the luminance flow entering the eye, and it has been argued that temporal changes in the retinal image play important roles in the establishment of spatial representations. Thus, the visual system could, in principle, benefit from these modulations. Here we examined whether the luminance transients resulting from eye blinks enhance visual sensitivity. In a forced-choice task, human observers (N=9) were asked to report the orientation (±45°) of a 3 cycle/degree grating displayed at full screen (21°×11.8°) for 2.5 s. Stimulus contrast was individually adjusted to yield ~80% correct responses. To minimize presentation transients, the stimulus slowly ramped up over a period of 1.5 s. We compared performance in trials in which subjects did and did not execute voluntary blinks. The proportion of correct responses was higher in the presence of blinks, leading to a small but significant increment that occurred despite the relatively long absence of retinal stimulation in the blink trials (~150 ms). Similar results were also obtained in a control experiment in which subjects did not blink, but blink transients were simulated by temporally modulating the luminance of the display. This sensitivity enhancement is consistent with the strong responses to blink transients exhibited by standard models of

ganglion cells, which were exposed to reconstructions of the visual input signals experienced by the subjects in our experiments. These results support the proposal that luminance transients caused by eye blinks enhance visual sensitivity.

Acknowledgements: NIH EY18363

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1357

Scene Perception: Processing, development

Global scene similarity structure predicts memory performance

Talk Presentation - *Topic area: Scene Perception: Processing, development*

Hayden M Schill[1] (hschill@ucsd.edu), Timothy F Brady[1]; [1]Department of Psychology, University of California, San Diego

Memory for low-level features such as color and orientation can be explained using a signal-detection model that takes into account perceptual similarity (Schurgin, Wixted, Brady, 2018). Such similarity falls off as an approximately exponential function of distance in perceptual space, similar to the extent of overlap in corresponding neural populations. Can perceptual similarity judgements for higher-level representations such as scenes predict scene memory? In scenes, similarity judgments and memory must depend on much richer representations than simple overlap in a single neural population (e.g., categorization depends on function: Greene et al. 2016; memory on conceptual overlap: Konkle et al. 2010). In order to assess this, we created a new continuous scene space database by extracting temporally evenly spaced frames from videos shot from drones, resulting in 100 unique categories with a gradient of similarity of scenes in each. In a similarity task, we presented N=100 UCSD undergraduate participants with two images at a time and asked them to rate their similarity on a continuous scale. As expected, similarity judgments were complex and not well explained by simple low-level feature overlap, though global measures such as color histograms and histograms of oriented gradients did predict significant amounts of similarity variance. In order to see if similarity ratings predict memory confusability, we then conducted an independent memory experiment

(N=200) on Prolific, where participants viewed 100 categorically distinct images and then did a 2-AFC memory test. We found that participants' judgements of similarity explained almost 50% of the explainable variance in memory performance ($p<0.0001$). Thus, memory confusability is linearly predicted by independent similarity ratings. Both are themselves complex, however, depending on functional and conceptual features rather than perceptual features. This is broadly consistent with the case of simple features, as well with theories of recognition memory that depend on similarity (e.g., Nosofsky, 1992).

Acknowledgements: NSF BCS-1829434 to TFB

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 614

Late development of navigationally-relevant motion processing in the occipital place area

Talk Presentation - *Topic area: Scene Perception: Processing, development*

Frederik Kamps[1] (fkamps@mit.edu), Jordan Pincus[2], Samaher Radwan[2], Stephanie Wahab[2], Daniel Dilks[2]; [1]Massachusetts Institute of Technology, [2]Emory University

Human adults flawlessly and effortlessly navigate boundaries and obstacles in the immediately visible environment, a process we refer to as "visually-guided navigation". Neuroimaging work in adults suggests this ability depends in part on the occipital place area (OPA) – a scene-selective region in the dorsal stream that selectively represents information necessary for visually-guided navigation. Despite progress in understanding the neural basis of visually-guided navigation, however, almost nothing is known about how this system develops. Is navigationally-relevant information processing present in the first few years of life? Or does this information processing only develop after many years of experience? Although a handful of studies have found selective responses to scenes (relative to objects) in OPA in childhood, no study has explored how more specific navigationally-relevant information processing emerges in this region. Here we do just that by measuring OPA responses to first-person perspective motion information – a proxy for the visual experience of actually navigating the immediate environment – using fMRI in 5 (N = 16) and 8 (N = 16) year old children. We found that although OPA already responded more to scenes than objects by age 5, responses to first-person perspective motion were not yet detectable at this same age, and rather only emerged by age 8. This protracted development was specific to first-person perspective motion through

scenes, not motion on faces or objects, and was not found in other scene-selective regions (the parahippocampal place area or retrosplenial complex) or a motion-selective region (MT). These findings therefore suggest that navigationally-relevant information processing in OPA undergoes prolonged development across childhood.

This talk will be presented in Live Talk Session 7, Tuesday, 23 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 191

Semantic knowledge guides attention in real-world scenes

Talk Presentation - *Topic area: Scene Perception: Processing, development*

Taylor R. Hayes[1] (trhayes@ucdavis.edu), John M. Henderson[1]; [1]University of California, Davis

Stored semantic knowledge gained through experience is theorized to play a critical role in determining the attentional priority of objects in real-world scenes. However, the link between semantic knowledge and attention is largely unknown due to the difficulty of quantifying semantics. The present study tested the link between stored semantic knowledge and scene attention by combining vector-space models of word semantics derived from how we use words in written text and crowd-sourced knowledge about the world with eye movements in real-world scenes. Within this approach, the vector-space model of word semantics (i.e., ConceptNet Numberbatch; Speer, Chin, & Havasi, 2016) served as a proxy for stored semantic knowledge gained from experience, and eye movements served as an index of attentional priority in scenes. Participants (N=100) viewed 100 real-world scenes for 12 seconds each while performing memorization and aesthetic judgment tasks. A representation of the spatial distribution of object semantics in each scene was built by segmenting and labeling all objects, computing the mean cosine similarity between each object and the other objects in that scene using ConceptNet, and then adding the mean object similarity values for the locations that objects occupied within the scene. We then applied a logistic general linear mixed effects model to examine how a scene region's semantic value was related to its likelihood of being fixated with subject and scene as random effects. The results showed that the higher the semantic value of a scene region, the more likely that region was to be fixated. These findings help bridge the gap between the theorized role of stored semantic knowledge and attentional control during scene viewing and also highlight the usefulness of models of word semantics to test theories of scene attention.

Acknowledgements: Supported by the National Institutes of Health (NEI) under award number R01EY027792.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

MY TALK IS ALSO AVAILABLE ON GOOGLE DRIVE (in case of technical difficulties) :
https://drive.google.com/file/d/19UecQgOegh4CLiW8VEZcMxRkGdb9_ZY_/view?usp=sharing

My Website: https://trhayes.org
My Email: trhayes@ucdavis.edu
Visual Cognition Lab: https://viscoglab.ucdavis.edu
Center for Mind and Brain at UC Davis: https://mindbrain.ucdavis.edu

Abstract ID: 583

That just doesn't add up: Continuous visual features fail to determine the number of items, and number behavior, in visual scenes

Talk Presentation - *Topic area: Scene Perception: Processing, development*

Emily Sanford[1] (esanfor4@jhu.edu), Justin Halberda[1]; [1]Johns Hopkins University

How do we determine the number of things in a scene? Previous research has suggested that seemingly number sensitive behavior may not reflect the representation of number per se but may instead result from a summation of information across low-level, non-numerical features (e.g., Dakin et al., 2011; Durgin, 2008; Gebuis et al., 2016). We took two approaches in evaluating the validity of this claim. First, we investigated whether number could be predicted from continuous features in children's counting books and real-world images, supposing that humans' number extraction abilities could have been acquired through the learning of this relationship. In both datasets, the number of items in the scene was not reliably predicted by any individual continuous feature nor by their linear combination. Further, these features failed to predict signatures of human number perception such as scalar variability. Next, we evaluated the extent to which peoples' representations of non-numerical visual features predict their numerical responses. Subjects estimated the convex hull, average area and number of objects in children's book illustrations and real-world photographs. Subjects had more precise representations for number than continuous features (Counting books: $F(2,39) = 16.77$, $p < .001$; Real-world photographs: $F(2,21) = 14.64$, $p < .001$). Additionally, subjects' number responses were much better accounted for by the actual number of objects in the image than by their non-numerical judgments on the same images (Counting books:

R2Continuous Features = .28, R2Number = .92; Real-world photographs: R2Continuous Features = .03, R2Number = .41). This indicates that subjects were not computing a combination of their internal representations of continuous features to derive a number response but instead responded directly to the number of items in the scene. We conclude that number representations do not reduce to simple combinations of non-numerical features and that the content of number representations is truly numerical.

Acknowledgements: National Science Foundation Graduate Research Fellowship Program

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 751

When will AI misclassify? Human intuition for machine (mis)perception

Talk Presentation - *Topic area: Scene Perception: Processing, development*

Zhenglong Zhou[1] (zzhou34@sas.upenn.edu), Makaela Nartker[2], Chaz Firestone[2]; [1]University of Pennsylvania, [2]Johns Hopkins University

Intelligent machines now match human-level benchmarks in categorizing natural images, and even predict human brain activity—raising the exciting possibility that such systems meaningfully replicate aspects of human visual processing. However, a powerful reason to doubt such resemblance is that DNNs commit bizarre and unhumanlike errors. Such errors can be elicited by artificially generated “adversarial images”, which induce high-confidence misclassifications from DNNs. But even more alarmingly, high-confidence misclassifications can also arise from unmodified natural images that could actually appear in the real world—as when a honeycomb-patterned umbrella is misclassified as a “chainlink fence”, or a bird casting a shadow is called a “sundial”. These errors are widely taken to reveal a fundamental disconnect between human and machine vision, because of how surprising and unpredictable they seem from a human’s perspective. But are they really so counterintuitive? Here, three experiments (N=600) ask whether naive human subjects can anticipate when and how machines will misclassify natural images. Experiment 1 showed subjects ordinary images that machines classify correctly or incorrectly, and simply asked them to guess whether the machines got them right or wrong; remarkably, ordinary people could accurately predict which images machines would misclassify (E1). Follow-up experiments showed that subjects were also

sensitive to how such images would be misclassified, by successfully predicting which images would receive which incorrect labels (E2), and in ways that couldn't be explained by motivational factors or task demands (since "fake" labels failed to produce similar results; E3). That humans can intuit the (mis)perceptions of sophisticated machines has implications not only for the practical purpose of anticipating machine failures (e.g., when a human must decide to take the wheel from an auto-pilot), but also for the theoretical purpose of evaluating the representational overlap between human and machine vision.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1325

Spatial Vision: Crowding, eccentricity

Category Rule Learning Transfers to Target Verification but Often Fails to Transfer to Search Guidance

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Ashley Ercolino[1] (ashley.ercolino@ucf.edu), Clay Killingsworth[1], Corey Bohil[1], Mark Neider[1], Joseph Schmidt[1]; [1]University of Central Florida

Models of categorical search suggest there is a cyclical process in which attention is guided to the most category-consistent peripheral stimulus, which is subsequently categorized. This process repeats until the target is found or search terminates (Yu, et al., 2016). We asked if the same classification rule is used to guide attention to peripheral stimuli, and to categorize it. Compared to foveal categorization, low-acuity categorization in peripheral vision would be akin to making the categories less discriminable. Categories learned via explicit rule (RB) are more easily generalizable to stimuli in new feature spaces than categories learned via implicit rule (II; Casale, et al., 2012). Accordingly, we hypothesized that categorization rule use would transfer to search guidance moreso in RB relative to II. Participants learned to categorize sinusoidal gratings using an RB or II rule and then completed a search task in which eye-movements were recorded. Decision-bound models identified the rule participants used in category learning, and to direct attention to and verify the target during categorical search. Categorization and search target verification generally resulted in participants using an optimal classification rule (an integration or independent decision rule) regardless of categorization condition. However, categorical guidance, defined as the percentage of target

first fixations, showed that only 30% of II participants used the optimal classification strategy, as opposed to 60% of RB participants. This suggests a disassociation between the rule used to categorize foveally and the rule used to categorize peripherally, with a larger discrepancy in II relative to RB. When examining search performance, participants who used the optimal rule to guide search had smaller RTs and stronger guidance (both, $p<.05$), regardless of condition. This suggests that despite demonstrating robust search guidance and the ability to categorize stimuli foveally, the optimal classification rule often fails to transfer to search guidance.

Acknowledgements: Research reported in this publication was supported by the National Eye Institute of the National Institutes of Health under Award Number R15EY029511. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1157

Differential effects of exogenous and endogenous covert attention on contrast sensitivity across spatial frequency and eccentricity

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Michael Jigo[1] (michael.jigo@nyu.edu), Marisa Carrasco[1]; [1]New York University

[Goal] Covert spatial attention (selection of spatial locations without eye movements) increases contrast sensitivity (CS) in sparse and crowded displays by enhancing the target's representation and/or suppressing distractors. These benefits occur inflexibly for exogenous attention and flexibly for endogenous attention. To constrain visual attention models, for the first time, we systematically characterized how target enhancement and distractor suppression by exogenous and endogenous attention vary across spatial frequency (SF) and eccentricity within the same observers. [Methods] Observers performed a 2AFC orientation discrimination task. Tilted (±45°) grating(s) were displayed along the horizontal meridian on both sides of a fixation cross. In the Valid conditions, peripheral precues manipulated exogenous attention and central precues manipulated endogenous attention. In the Neutral conditions, non-informative precues distributed attention across the visual field. Response cues indicated the target. In Experiment 1, a single grating with one of 6 SFs (0.5-11 cpd) was displayed at 4 possible eccentricities (0-12°). Five levels of grating

contrast encompassed the participant's dynamic range, enabling estimates of CS. In Experiment 2, 4 gratings were displayed simultaneously with one of 8 SFs (0.5-11 cpd) and at 2 eccentricities (2°, 6°). On each trial, gratings had the same SF and their contrasts were fixed (based on initial threshold sessions) such that Neutral performance was matched across SF and eccentricity. [Results and Conclusion] In Experiment 1, Neutral and Valid CS were bandpass across SF and declined with eccentricity. In Experiment 2, Neutral performance (d') was equated across SF and eccentricity. In both experiments, exogenous attention yielded the largest benefits for SFs above the Neutral preferred SF at each eccentricity, and more so for peripheral locations. In contrast, endogenous attention improved a broad range of lower and higher SFs. Our results highlight how these two types of covert attention distinctly shape basic perceptual dimensions across the visual field.

Acknowledgements: NIH NEI R01-EY019693

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Thank you for visiting our poster.

This work has been published in Journal of Vision:
Jigo, M., & Carrasco, M. (2020). Differential impact of exogenous and endogenous attention on the contrast sensitivity function across eccentricity. Journal of Vision, 20(6):11, 1–25, https://doi.org/10.1167/jov.20.6.11

If you have additional questions, please leave a message in the chat or send an email to michael.jigo@nyu.edu.

Abstract ID: 1223

Dynamic vision in the extreme-periphery: Perception of flicker rate

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Sara Adams[1] (sadams@caltech.edu), Daw-An Wu[1], Shinsuke Shimojo[1,2]; [1]Biology and Biological Engineering, California Institute of Technology, [2]Computation and Neural Systems, California Institute of Technology

Previously, we reported that flickering stimuli appeared to flicker more rapidly when viewed in the extreme periphery (Shimojo et. al. VSS 2019). Here, we explore this effect in more quantitative detail. Two back-

projection screens stood at a 90˚ angle, forming a panoramic display. A single ProPixx projector cast its video across both screens with a 1440 Hz refresh rate. Typical stimuli were a pair of disks (2-4˚), with one presented at the fovea and the other in the periphery (15-90˚). Flicker frequencies ranged from 2-15 Hz. Observers performed a variety of tasks: simultaneous matching by adjusting rate of foveal or peripheral stimulus, reproduction from memory, or categorical response (faster/slower). Observers' subjective reports and task responses revealed large attention and memory effects: during matching tasks, the perceived rate seemed to fluctuate as attention shifted between observing the reference stimulus and adjusting the test stimulus. Reproduction from memory showed large anchoring effects—participants had difficulty remembering the reference rate while manipulating the test stimulus. Categorical reports on simultaneously presented stimuli were more stable, providing psychometric functions for stimuli presented at different rates and eccentricities. So far, we have seen the strongest effects for flickers ranging from 5-13 Hz. The effect of eccentricity varied depending on frequency. At the upper end of frequencies, the effect remained level across a wide range of eccentricities. At the lower end, the effect increased as eccentricity increased. This effect of eccentricity was somewhat greater when presenting disks alternating between black and white on a gray background, as opposed to white disks flashing upon a black background. The gray background stimulus also induced an action capture effect (see Wu et al, VSS 2020). Further experiments will explore more parameter space, other types of feature changes, cross-modal interactions, and neural correlates in EEG spectra.

Acknowledgements: Yamaha Motor Corporation USA, JST-CREST

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1714

Fixational eye movements and crowding in the foveola.

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Ashley Clark[1] (aclark43@ur.rochester.edu), Janis Intoy[2], Haizhu Yang[3], Martina Poletti[4]; [1]University of Rochester, [2]Boston University

Visual crowding, the inability to recognize objects in clutter, has been studied for decades. While most research has focused on its effects in the visual periphery, this phenomenon has been minimally studied in the foveola, the 1-degree retinal region where visual acuity is highest. Fixational eye movements, in particular ocular drift, continually shift retinal projections of objects across the foveola. While they may not

influence peripheral crowding, they may play a role when crowded stimuli are presented foveally. To address these issues, we assessed the effects of crowding at the foveal scale while tracking gaze position with high precision. Emmetropic subjects (n = 9) were instructed to identify a target, which was either presented alone (uncrowded condition) or surrounded by four flakers of the same size (crowded condition). Stimuli, presented foveally, consisted of Pelli-font numbers designed specifically for studying crowding in the fovea. The threshold strokewidth of the target was calculated in both conditions using an adaptive procedure. In the crowded condition, both target size and flanker spacing changed together. Our findings show that crowding occurs at the foveal scale. With identical stimulus size, visual discrimination is impaired when a foveal stimulus is surrounded by flankers. On average, target size needs to increase 0.63 ± 0.39 arcmin (an increase of 40%) for performance to be comparable to the uncrowded condition. While ocular drift was unaffected by target size, our results indicate that individuals with larger strokewidth thresholds were characterized by larger drifts in both the uncrowded and crowded condition. Furthermore, the larger the difference in strokewidth thresholds, the larger the difference in drift span between crowded and uncrowded conditions. This evidence suggests that foveal crowding is not only determined by retinal and cortical factors, but fixational eye movements may play a crucial role in modulating its strength.

Acknowledgements: BCS-1534932 and NIH R01 EY029788-01, F31EY029565

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1514

Perception is dominated by the peripheral item: Testing the mechanisms underlying the crowding effect through the inner–outer asymmetry

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Adi Shechter[1,3] (ashechter05@gmail.com), Amit Yashar[2,3]; [1]Department of Learning Disabilities, Faculty of Education, University of Haifa, [2]Department of Special Education, Faculty of Education, University of Haifa, [3]The Edmond J. Safra Brain Research Center for the Study of Learning Disabilities, University of Haifa

Background. Crowding refers to the failure to identify a peripheral item when it is presented along with nearby flankers. A hallmark property of crowding is the inner-outer asymmetry; the outer flanker

(eccentric) produces stronger interference than the inner one. Here we investigated the asymmetry effect using an estimation report in order to test the predictions of competing crowding models: pooling vs. substitution. Pooling models suggest that the outer flanker is more integrated with the target, which predicts either averaging errors with the outer flanker or mis-reports of the inner flanker (the less integrated flanker). Substitution models, on the other hand, suggest confusion between the target and the outer flanker, which predicts mis-reports of the outer flanker. Method. Observers (n=22) estimated the orientation of a Gabor using a continuous report. The target was presented at 7° eccentricity. In the crowding conditions, two distractors flanked the target, one on each side, along the horizontal meridian. We characterized crowding errors with respect to each distractor separately, by fitting probabilistic models to the error distributions. Results. Under crowding conditions, instead of the target, observers mistakenly reported (misreport errors) the outer flanker (eccentric), but not the inner flanker (closer to the fovea). This finding is in accordance with the prediction of the substitution models. Conclusions. Our results reveal a counterintuitive finding: perception is dominated by the peripheral item rather than the one closer to the center of the visual field. Importantly, our findings support the substitution account. Namely, increased location uncertainty in the periphery, due to larger receptive fields, leads to confusion between the target and the outer flanker.

Acknowledgements: This work was supported by The Israeli Science Foundation Grant Nos. 1980/18 (to A. Yashar).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 869

Spatial Attention within Dynamic Receptive Field Pooling Arrays: Implications for Visual Crowding and Convolutional Neural Networks

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Joel Bowen[1] (joel_bowen@berkeley.edu), Justin Theiss[1], Michael Silver[1]; [1]University of California, Berkeley

Any visual system – biological or artificial – has an inherent trade-off between the number of units used to represent the visual environment and the spatial resolution of the sampling array. The human visual system is able to locally allocate attention to reconfigure its sampling array (cortical receptive fields (RFs)), thereby enhancing spatial resolution at attended locations in the visual field without changing the overall number

of sampling units. Here, we examine how features in a convolutional neural network interact and interfere with each other in an eccentricity-dependent RF pooling array and how these interactions are influenced by dynamic changes in spatial resolution across the array. We study feature interactions within the framework of visual crowding, a well-characterized perceptual phenomenon in which target objects in the visual periphery that are easily identified in isolation are much more difficult to identify when flanked by similar nearby objects. Our model replicates basic properties of human visual crowding, including anisotropies based on inner/outer and radial/tangential spatial configurations of targets and flankers. Moreover, by separately simulating effects of spatial attention on RF size and density of the pooling array, we demonstrate that increased density is more beneficial than size changes for enhancing target classification in crowded stimuli. Finally, we separately compare effects of attention and target-flanker spacing on visual crowding and find that enhanced redundancy of feature representation (due to increased density of RFs at the target location with attention) has more influence on target classification than enhanced fidelity of the feature representations themselves (due to increased target-flanker spacing). These results provide 1) insights into the use of dynamic RF pooling arrays in artificial neural networks and 2) testable hypotheses for future perceptual and physiological studies of visual crowding.

Acknowledgements: NIH R01 EY025278

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 905

The Role of Peripheral Vision and Attention in Change Blindness

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Maverick E. Smith[1] (ms1434@ksu.edu), Dara El-Shaarawi[1], Yuhang Ma[1], Ellie Wilson[1], Lauren Salee[1], Ruth Rosenholtz[2], Lester C. Loschky[1]; [1]Kansas State University, [2]Massachusetts Institute of Technology

How do the limits of peripheral vision versus the effects of attentional selection influence change blindness? We investigated this in four Experiments. We first characterizing the difficulty of numerous change blindness demonstrations using the standard Flicker paradigm in Experiment 1. Experiment 2 evaluated viewers' ability to peripherally discriminate change pairs of varying difficulty when changes were fully attended. We first showed participants a change. Participants then fixated predetermined locations, 1.25-10 degrees eccentricity from each change, and performed a peripheral ABX discrimination task for versions A and B. Discrimination performance declined with increasing eccentricity for changes “difficult” to find in the Flicker paradigm, but “easy” changes showed little effect of eccentricity. Experiment 3 simulated the effects of crowding in peripheral vision using the Texture Tiling Model (TTM). We created “mongrel” texture versions of each image pair, with simulated “foveation” at each of the fixation locations and eccentricities of Experiment 2. Participants’ discriminated whether each mongrel was generated from image version A or B. Performance decreased with simulated eccentricity, with a steeper slope for “difficult” change pairs than “easy” pairs, suggesting that peripheral information loss partially explains change blindness. In Experiment 4, we manipulated attention to the change by manipulating participants’ knowledge of the change before the ABX peripheral task. The pre-cued condition (same as Experiment 2) replicated the finding that the changes easiest to peripherally discriminate were those easiest to find in the Flicker paradigm. However, un-cued “difficult” changes were uniformly poorly discriminated at all eccentricities, and “easy” changes were only above-chance at 1.25 deg eccentricity. This suggests that change detection involves two stages: 1) attending to the change; 2) peripherally or foveally discriminating the two versions. Thus, both attentional selection and the limitations of peripheral vision influence change detection. The latter can be roughly approximated by the TTM.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Please sign-up for the upcoming Journal article using this google spreadsheet:
https://docs.google.com/spreadsheets/d/1XB9CaWiKz9H3io3l8MbWPufl2CPQd6UBc-XmUqu-q1A/edit?usp=sharing

Abstract ID: 1538

Why does a disk subjectively disappear in Ninio’s extinction illusion?

Poster Presentation - *Topic area: Spatial Vision: Crowding, eccentricity*

Lana OKUBO[1,2] (okubo@l.u-tokyo.ac.jp), Kazuhiko YOKOSAWA[1], Masataka SAWAYAMA[2], Takahiro KAWABE[2]; [1]The University of Tokyo, [2]NTT Communication Science Laboratories

People generally believe that they can coherently comprehend the entire visual field. Counterintuitively, however, several psychophysical phenomena show that visual objects in the peripheral visual field go unnoticed. For example, in Ninio’s extinction illusion, a dark disk at the intersection of gray grids against a white background often goes unnoticed even though the contrast level of the disk is supra-threshold. Why

do observers fail to be aware of the disk in this illusion? By combining a psychophysical experiment with a computational analysis, we tested a hypothesis that the visual system does not distinguish the signal of the disk at the intersections of the gray grid from the signal of just the intersections, and interpret that the disk does not exist at the intersections. In the psychophysical experiment, a disk was presented at or near one of four grid intersections in half of the trials. Results indicated that the sensitivity (d') for detecting the disk at the intersection (but not near the intersection) decreased with the disk eccentricity. In the computational analysis, the energy relationship between the visual signal of the disk at the intersection and the signal of the intersection was evaluated. The two-dimensional difference of Gaussians with various sigma sizes was convolved with the stimuli, and the energy ratio of the disk signal to the sum of the disk signal and the intersection signal were calculated. Results indicated that the energy ratio decreased with the stimulus eccentricity when spatial frequency analysis in the periphery was considered. Moreover, the d' for detecting the disk as a function of eccentricity was well described by the exponential function of the energy ratio. These results indicate that the indistinguishability of the disk signal from the intersection signal causes the disk to subjectively disappear in the extinction illusion.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 723

Spatial Vision: Mechanisms

Analysis and systhesis of natural texture perception by EEG

Talk Presentation - *Topic area: Spatial Vision: Mechanisms*

Taiki Orima[1], Isamu Motoyoshi[1]; [1]Department of Life Sciences, The University of Tokyo

Recent psychophysical and neurophysiological evidence shows that human early visual cortex encodes the image statistics of natural textures. To investigate how the neural representation of texture statistics evolves over time, we performed a reverse-correlation analysis between visual evoked potentials (VEPs) to natural texture images and image statistics computed from those same textures. 15 observers viewed 166 achromatic images of various natural textures presented foveally for 500 ms in random order (x 24 for each image), and EEG signals were recoded from 19 electrodes. Additional recordings were made for the Portilla-Simoncelli (PS)-synthesized and phase-randomized versions of the original natural textures. We calculated correlation coefficients between VEPs and image statistics, including subband moment statistics and cross-

subband correlations. Our analysis showed that, for all stimulus versions, image statistics are manifestly correlated (max r=~0.8) with texture VEPs at systematically different timings; e.g., subband SDs at low, middle, and high spatial frequencies were correlated with VEPs at 100, 120, 150 ms respectively. Significant correlations were also observed between VEPs and PS statistics. Based on these data, we further carried out a VEPs-to-PS statistics inverse reconstruction by applying the partial least squared (PLS) regression analysis between VEPs (125 points) and compact PS statistics (110 vectors). 5 components were obtained, as determined by 10 folds cross-validation. Coefficient matrixes generated from training data (90 % of stimuli) successfully synthesized a portion of textures that were perceptually very similar to the original PS-synthesized textures. These findings suggest that simple VEPs elicited by natural textures contain information about the dynamics of cortical responses to image statistics that is sufficiently rich to predict human perception.

Acknowledgements: Supported by the Commissioned Research of NICT (1940101), and by JSPS KAKENHI JP15H05916 and JP18H04935.

This talk will be presented in Live Talk Session 6, Tuesday, 23 June, 7:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 648

Asymmetries around the visual field in human visual cortex

Talk Presentation - *Topic area: Spatial Vision: Mechanisms*

Noah C. Benson[1] (nben@nyu.edu), Eline R. Kupers[1], Marisa Carrasco[1], Jonathan Winawer[1]; [1]Dept. of Psychology, New York University

[BACKGROUND] Visual performance in many tasks, including acuity and contrast sensitivity, declines precipitously with eccentricity. Performance also varies substantially around the visual field at isoeccentric locations: Performance is better on the horizontal than vertical meridian (horizontal-vertical asymmetry, “HVA”) and better on the lower than upper vertical meridian (vertical meridian asymmetry, “VMA”) (Carrasco, Talgar, Cameron, 2001). These two asymmetries decrease gradually from the cardinal meridia (Abrams, Nizam, Carrasco, 2012). Here, we quantified asymmetries around the visual field in terms of surface area in human visual cortex. [METHODS] We used the Human Connectome Project retinotopy dataset (n=181; Benson et al., 2018) to characterize the cortical HVA and VMA. We computed the percent

difference in cortical surface area for V1/V2 regions of interest (ROIs) near the cardinal meridia (upper vs lower, VMA; horizontal vs vertical, HVA). To test the angular specificity of these asymmetries, we defined several wedge-shaped ROIs surrounding each cardinal meridian, ranging in width from narrow to wide (±10° to ±50° of polar angle from the meridia). All ROIs were restricted to 1-6º eccentricity. [RESULTS] We find that cortical surface area in V1 and V2 is distributed asymmetrically around the visual field with greater area for the lower than the upper visual field (maximum VMA ≈ 46% at ±10°) and for the horizontal than vertical meridia (maximum HVA ≈ 54% at ±20°). The asymmetries are largest for the narrowest wedges and decrease gradually with angular distance from the meridia. This pattern matches the behavioral asymmetries, which also decrease gradually away from the meridia, indicating a close correspondence between psychophysical performance and cortical representations in early visual retinotopic maps.

Acknowledgements: NEI Grant R01-EY027401

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 543

Beyond fixation: foveal receptive field estimation in freely viewing primates

Talk Presentation - *Topic area: Spatial Vision: Mechanisms*

Jacob Yates[1,2,3], Shanna Coop[1,2], Gabriel Sarch[1], Ruei-Jr Wu[1,2], Daniel Butts[3], Michele Rucci[1,2], Jude Mitchell[1,2]; [1]Brain and Cognitive Science, University of Rochester, [2]Center for Visual Science, University of Rochester, [3]Department of Biology, University of Maryland College Park

During natural vision, primates move their eyes constantly to position objects of interest onto the high-resolution region of the retina, the fovea. Eye movements also continue to occur even after objects are foveated, raising the question of how eye movements affect foveal processing of vision. Remarkably, despite the disproportionate importance of this region, we know very little about the response characteristics of neurons responsible for foveal vision. This is primarily the consequence of technical difficulty in mapping receptive fields in the fovea, which tend to be small and move with the eyes, even during the fixational periods in between saccades. Here, we combine high-resolution eye tracking, large-

scale neurophysiology, and advanced statistical models to study foveal processing during natural visual behavior in neurons in primary visual cortex (V1) of marmoset monkeys. Using a digital Dual-Purkinje eye tracker (dDPI) that was recently developed in the Rucci lab, we can measure the eye position of marmosets with unprecedented precision. We record from multiple laminar electrode arrays that are semi-chronically implanted in the foveal representation in V1 while marmosets freely view large visual stimuli or search for small Gabor targets positioned randomly in the visual field. After correcting for the eye position offline, we reconstruct the retinal input for the neurons under study, which then forms the input for likelihood-based neural models. Using this approach, we can recover receptive-field subunits of foveal V1 neurons that are 1/10 of one degree of visual angle. Our statistical modeling approach additionally allows us to account for shared extra-retinal modulations of the neural population while simultaneously characterizing the response to the visual input. This approach opens the ability to study visual responses in the fovea in natural viewing contexts beyond standard fixation paradigms.

Acknowledgements: Funding: NIMH R21 MH104756, U01 NS 094330, NIH T32 EY007125, NIH R01 EY018363. J.L.Y is an Open Philanthropy fellow of the Life Sciences Research Foundation.

This talk will be presented in Live Talk Session 3, Sunday, 21 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1470

Neural adaptation to optical aberrations through phase compensation

Talk Presentation - *Topic area: Spatial Vision: Mechanisms*

Antoine Barbot[1,2,4], John Pirog[1,3], Cherlyn Ng[1,2], Geunyoung Yoon[1,2,3]; [1]Flaum Eye Institute, University of Rochester Medical Center, [2]Center for Visual Science, University of Rochester, [3]Institute of Optics, University of Rochester, [4]Spinoza Centre for Neuroimaging, Amsterdam

Background–Human vision is intrinsically limited by optical blur, which degrades retinal image quality by reducing contrast and disrupting the phase of transmitted spatial frequency (SF) information. Many studies have shown that the visual system can compensate for blur-induced reductions in contrast and visual acuity via gain control mechanisms. However, perceptually relevant information about the structure of an image is almost exclusively contained within the phase spectrum, rather than the amplitude spectrum. Yet, it is unclear whether the brain can compensate for phase scrambling effects of optical blur. Here, we introduce a novel approach combining visual psychophysics and adaptive optics (AO) techniques to assess whether neural adaptation to blur compensates for disrupted phase congruency induced by optical aberrations, following both short-term and long-term exposure to degraded retinal images. Method and Results–Participants judged the appearance of suprathreshold compound grating stimuli consisting of two sinusoids (frequencies f and 2f) varying in relative phase. AO was used to fully correct or induce optical aberrations while measuring perceived phase congruency. Human participants were sensitive to both physical phase shifts and blur-induced alterations of phase congruency. Under AO-induced optical aberrations, the magnitude and direction of perceived phase shifts matched predictions from optical theory. Moreover, during short-term adaptation (~1h) to AO-induced blur, we found that the magnitude of the perceived phase shift decreased with time and was followed by an after-effect in the opposite direction, consistent with neural compensation to phase spectra. A control condition ruled out changes in response bias or fatigue as possible explanations. Finally, patients with keratoconus–a corneal disease resulting in long-term adaptation (up to 10-20 years) to severe optical aberrations–exhibited altered phase congruency when tested under aberration-free AO condition. Conclusion–Our findings reveal the existence of neural compensation mechanisms to phase spectra that attenuate the impact of blur on phase congruency over time.

Acknowledgements: NIH Grant EY014999 and Research to Prevent Blindness (RPB) to GY; H2020-MSCA-IF to AB

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1130

The effect of eye movements on visual crowding in congenital nystagmus

Talk Presentation - *Topic area: Spatial Vision: Mechanisms*

Vijay K Tailor[1,2], Maria Theodorou[2], Annegret H Dahlmann-Noor[2], John A Greenwood[1]; [1]University College London, [2]Moorfields Eye Hospital NHS Foundation Trust

Congenital nystagmus is a disorder characterised by involuntary eye movements (horizontal in direction), with associated deficits in visual acuity and elevations in crowding, a process whereby objects that are visible in isolation become indistinguishable in clutter. We sought to understand the origin of these foveal crowding effects. If nystagmic crowding derives from image motion, crowding should have a disproportionate effect with horizontally arranged flankers (due to horizontal eye motion) compared to vertically placed flankers. In contrast, if crowding was due to a sensory deficit derived from enlarged receptive fields, crowding effects in each dimension should be matched. Observers judged the orientation of a target Landolt C presented foveally in 3 conditions: the target alone (to measure acuity), or crowded with either horizontal or vertical Landolt-C flankers. A QUEST procedure was used to vary gap size (with flankers and element spacing scaled accordingly). Thresholds were taken as the size required to reach 62.5% correct. Overall, we found elevations in both crowded conditions relative to acuity. These elevations were greater for nystagmats (n=8) than controls (n=10). Consistent with predictions based on image motion, crowding was significantly larger with horizontally- vs. vertically-positioned flankers for nystagmats, unlike controls where thresholds were both equally elevated relative to the acuity baseline. We next simulated nystagmic crowding in controls (n=10) by moving stimuli in the above 3 conditions, according to eye-movement recordings of patients with nystagmus. Observers were required to either follow the stimulus or maintain fixation. Crowding thresholds were elevated, particularly in the fixation condition, with worse performance for horizontal vs. vertical flankers (as seen with nystagmus). The presence of elevated horizontal crowding in nystagmats and controls (when stimuli moved with simulated nystagmus) suggests that the eye movement-induced smear of target and flanker elements is the cause of nystagmic crowding, rather than a long-term sensory deficit.

Acknowledgements: I would like to gratefully acknowledge Moorfields Eye Charity for the PhD studentship award and funding.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 711

Two-photon imaging of V1 responses to “pop-out” texture patterns in awake macaques

Talk Presentation - *Topic area: Spatial Vision: Mechanisms*

Xingnan ZHAO[1], Shuchen GUAN[1], Shiming TANG[1], Cong YU[1]; [1]Peking University

A line segment among an array of uniformly differently oriented line segments can be detected effortlessly. Various experimental and modeling studies have linked this ‘pop-out’ phenomenon to V1 processing. Here we studied the V1 neuronal activities associated with visual “pop-out” in V1 superficial- layer neurons in awake macaques with two-photon calcium imaging (GCaMP5). The target stimulus was a drifting target Gabor (2-cycles/sec speed, 90%-contrast, 6-cpd SF, 2o- eccentricity) at various orientations. The surrounding stimuli were 1-2 rings of Gabors with uniform or random orientations around the center stimulus. Neuronal responses from 1119 orientation-tuned cells 150 µm deep from the cortical surface were recorded. When the target was surrounded by one ring of uniform Gabors, the cells’ optimal responses were suppressed, with stronger suppression at collinear orientation, and weaker suppression as surround orientation deviated from collinear, which floored at 45o deviation. Adding one or two more rings of Gabors at collinear orientation increased surround suppression, reducing the median R_sur/R_base ratio from 0.578 to 0.496 and 0.462. This trend persisted with surround stimulus orientation up to 22.5o deviation from collinear. In contrast, at 45o or larger deviation, increasing the number of surround rings reduced surround suppression. At orthogonal surround orientation, the R_sur/R_base ratio increased from 0.658 to 0.736 and 0.758. In addition, surround suppression by randomly oriented increased with more rings of surround stimuli, as in the case of collinear surround stimuli. These results demonstrate significantly lower surround suppression when a target is imbedded in orthogonal than in collinear surround stimuli, especially with the surround stimulus set is large and resembles “pop-out” textures (R_sur/R_base ratio = 0.758. Vs. 0.462 with 3 rings of orthogonal vs. collinear stimuli). In “pop-out” textures, far orthogonal surround stimuli may disinhibit near surround stimuli to relieve surround suppression and achieve a pop out percept.

Acknowledgements: Center for life sciences

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1746

Spatial Vision: Models

Computational validity of neuroimaging software: the case of population receptive fields

Talk Presentation - *Topic area: Spatial Vision: Models*

Garikoitz Lerma-Usabiaga[1,2] (garikoitz@gmail.com), Noah Benson[3], Jonathan Winawer[3], Brian Wandell[1]; [1]Department of Psychology, Stanford University, 450 Serra Mall, Jordan Hall Building, 94305 Stanford, California, USA, [2]BCBL. Basque Center on Cognition, Brain and Language. Mikeletegi Pasealekua 69, Donostia - San Sebastian, 20009 Gipuzkoa, Spain, [3]Department of Psychology and Center for Neural Science, New York University, 6 Washington Pl, New York, NY, 10003, USA

Neuroimaging software methods are complex, making it a near certainty that some implementations will contain errors. Modern computational techniques (i.e. public code and data repositories, continuous integration, containerization) enable the reproducibility of the analyses and reduce coding errors, but cannot guarantee the scientific validity of the results. It is difficult, nay impossible, for researchers to check the accuracy of software by reading the source code; ground truth test datasets are needed. Computational reproducibility means providing software so that for the same input anyone obtains the same result, right or wrong. Computational validity means obtaining the right result for the same input data. We describe a framework for validating and sharing software implementations. We apply the framework to an application: population receptive field (pRF) methods for functional MRI data. The framework is composed of three main components implemented with containerization methods to guarantee computational reproducibility: (1) synthesis of fMRI time series from ground-truth pRF parameters, (2) implementation of four public pRF analysis tools and standardization of inputs and outputs, and (3) report creation to compare the results with the ground truth parameters. The framework and methods can be extended to other critical neuroimaging algorithms. In assessing validity across four implementations, we found and reported five coding errors. Most importantly, our results showed imperfect parameter recovery, with variation in ground truth values of one parameter influencing recovery of other parameters. This effect was present in all implementations. The computational validity framework supports scientific rigor and creativity, as opposed to the oft-repeated suggestion that investigators rely upon a few agreed upon packages. Having validation frameworks help (a) developers to build new software, (b) research scientists to verify the software's accuracy, and (c) reviewers to evaluate the methods used in publications and grants.

Acknowledgements: This work was supported by a Marie Sklodowska-Curie (H2020-MSCA-IF-2017-795807-ReCiModel) grant to G.L.-U. We thank the Simons Foundation Autism Research Initiative and Weston Havens foundation for support.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 341

Models for discriminating blur from loss of contrast

Talk Presentation - *Topic area: Spatial Vision: Models*

Joshua Solomon[1] (j.a.solomon@city.ac.uk), Michael Morgan; [1]City, University of London

Using chessboard-like stimuli, Morgan (2017) found that human observers aren't merely capable of discriminating between different levels of stimulus contrast and stimulus blur (i.e. a selective loss of high spatial frequencies), they can also discriminate between these two image manipulations. How they do it isn't yet clear. Wang and Simoncelli (2004) demonstrated that a code for blur is inherent to the phase relationships between localized pattern detectors of different scale. To test whether human observers actually use local phase coherence when discriminating between blur and loss of contrast, we compared phase-scrambled chessboards with unscrambled chessboards. Although both stimuli had identical amplitude spectra, local phase coherence was disrupted by phase-scrambling. Human observers were required to concurrently detect and identify (as contrast or blur) image manipulations in the 2x2 forced-choice paradigm (Nachmias & Weber, 1975; Watson & Robson, 1981) traditionally considered to be a litmus test for "labelled lines" (i.e. detection mechanisms that can be distinguished on the basis of their preferred stimuli). Phase scrambling produced a marked reduction in the ability to discriminate between blur and a reduction in contrast. Nonetheless, none of our results (including those with unscrambled chessboards) passed Watson & Robson’s most stringent test for labelled lines. Models of performance fit significantly better when either a) the blur detector also responded to contrast modulations, b) the contrast detector also responded to blur modulations, or c) noise in the two detectors was anticorrelated.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 521

The Spatiotemporal Power Spectrum of Natural Human Vision

Talk Presentation - *Topic area: Spatial Vision: Models*

Vasha DuTell[1] (vasha@berkeley.edu), Agostino Gibaldi[1], Giulia Focarelli[1], Bruno Olshausen[1], Marty Banks[1]; [1]UC Berkeley

When engaging in natural tasks, the human visual system processes a highly dynamic visual data stream. The retina, performing the very first steps in this processing, is thought to be adapted to take advantage of low-level signal regularities, such as the autocorrelation function or power spectrum, to produce a more efficient encoding of the data (Atick & Redlich, 1992). Previous work examined the joint spatio-temporal power spectrum of handheld camera videos and Hollywood movies, showing that power falls as an inverse power-law function of spatial and temporal frequency, with an inseparable relationship (Dong & Attick, 1995). However these data are far from a true characterization of a day in the life of the retina due to body, head and eye motion. In addition, the distribution of natural tasks will influence the statistics of this signal. Here, we aim to characterize these statistics of natural vision using a custom device that consists of a head-mounted eye tracker coupled with high frame-rate world cameras and orientation sensors. Using video data captured from this setup, we analyze the joint spatiotemporal power spectrum for three conditions: 1) a static camera viewing a natural task being performed, 2) a head mounted camera worn by a subject engaged in a natural task, and 3) videos simulating the dynamic retinal image, created by overlaying the subject's eye motions on the head-mounted camera video stream. Results suggest that compared to a static camera, body and head motion have the effect of boosting high temporal frequencies. Eye motion enhances this effect, particularly for mid to high spatial frequencies, causing this portion to deviate from the power law and become nearly flat. These data will be important for developing efficient coding models relevant to natural vision.

Acknowledgements: We thank Emily Cooper, Hany Farid, Steve Cholewiak, and Teresa Cañas-Bajo for assistance in hardware & software design, and eye tracking. This work was supported by funding from the Center for Innovation in Vision and Optics, as well as the National Defense Science and Engineering Fellowship.

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1661

Spatial Vision: Neural mechanisms

A new model and a new demonstration of contrast sensitivity

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

David J Field[1] (djf3@cornell.edu), Damon M Chandler[2]; [1]Cornell University, [2]Shizuoka University

The standard model of contrast sensitivity is represented by the contrast sensitivity function (CSF) that shows sensitivity peaking around 4-8 cycles/degree and falling to zero around 40 cycle/deg. However, there are a number of problems with this model. One major problem is that it does a poor job at explaining our visual system's response to natural scenes that have amplitude spectra that fall off with frequency as 1/f. Although supra-threshold contrast matching studies show a flatter response function, this is still not a good match to natural scenes. In this talk, we introduce an approach to visual sensitivity that focuses on a neurons vector magnitude. We then propose the radical idea that visual sensitivity peaks around 30 cycles/deg. We provide a demonstration of this phenomenon with a chart of an array of log-Gabor functions plotting contrast magnitude against spatial frequency. We also show the results of a contrast matching experiment that supports this model. We argue that with this approach, the response to natural scenes is flat out to around 30 cycle/deg (i.e., the response effectively whitens the input). The approach explains why white noise appears to be dominated by high frequencies (not 4-8 cycles/deg) and argues that it is the highest frequency neurons that will produce the largest response to white noise (or a single pixel centered on their receptive field). We will note show how the optics of the eye modify these measures and show how eye movements may fit into this model (as proposed by Rucci and colleagues). Finally, we will use this approach to explain why the contrast sensitivity function has the shape that it does by distinguishing between the response magnitude of a neuron and the neuron's signal/noise level.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

Thanks for looking at our poster. We will be video conferencing for a couple hours on Sunday June 21 from 3-5 p.m.

Abstract ID: 811

Bayesian adaptive stimulus selection with real-time fMRI

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Steven M. Weisberg[1] (stevenweisberg@ufl.edu), Geoffery K. Aguirre[2]; [1]University of Florida, [2]University of Pennsylvania

In contrast to the method of constant stimuli, adaptive procedures dynamically select the next stimulus based upon the prior responses of the subject, and an underlying stimulus-response model. For fMRI

experiments that seek to measure the parameters of a neural response function, Bayesian adaptive stimulus selection (such as provided by QUEST+; Watson 2017) may provide better estimates of model parameters than traditional approaches. QUEST+ may be particularly useful in cases where the neural response is a function with multiple parameters, which must be fit simultaneously. Despite these advantages to adaptive stimulus selection, a complication is that QUEST+ considers responses as the proportion of outcomes within pre-defined, discrete bins, while BOLD fMRI data is a continuous signal with an uncertain amplitude and a varying baseline. To account for this, we have implemented a framework for QUEST+ fMRI that includes: 1) initial model fitting to the time-series to extract a gain parameter for each stimulus event, accounting for the hemodynamic response; 2) a procedure for dynamically updating the mapping between responses relative to a reference stimulus, and the fixed set of outcomes specified by QUEST+; 3) a Gaussian noise parameter that intercedes between the parameterized model of response and the proportions of observed outcomes. We examined the measurement of the V1 cortical response to a high-contrast stimulus flickering at different frequencies, as fit by a 4-parameter difference-of-exponential temporal sensitivity model. In simulations that model empirical data, we find that the QUEST+ approach recovers model parameters more accurately than does constant stimuli given a fixed acquisition length. This framework now allows us to optimize experimental design (e.g., the number and duration of stimulus types) given a neural response function to be measured.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thanks for your interest in our work!

For questions, please get in touch with Steven Weisberg via email: stevenweisberg [at] ufl [dot] edu, or on Twitter: @stevenmweisberg.

If you'd like a transcript of our video, please contact Steven Weisberg.

Abstract ID: 394

Biologically inspired unification of population receptive field models provides new insights into cortical computations

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Marco Aqil[1] (m.aqil@spinozacentre.nl), Tomas Knapen[1], Serge Dumoulin[1]; [1]Spinoza Centre for Neuroimaging, Vrije Universiteit Amsterdam

The method of population receptive fields (pRFs) allows quantitative modeling of brain activity responses to external stimuli, and has been used extensively to investigate cortical organization in health and disease (Dumoulin & Wandell, 2008, Dumoulin & Knapen, 2018). Since its introduction, the method has been extended to capture suppressive surrounds and compressive spatial summation (Zuiderbaan et al, 2012; Kay et al, 2013). Interestingly, suppressive surrounds explain more signal variance in early, but not late visual cortex; whereas the converse is true for compressive spatial summation. Divisive normalization has been proposed to underlie many psychophysical and neurological phenomena, and is a prime candidate for a canonical neural computation (Carandini & Heeger, 2012). Here, we build a pRF model based on divisive normalization and ask whether it can 1) unify previous pRF models and 2) provide new insights into cortical computations. We acquired ultra-high-resolution 7-Tesla BOLD-fMRI data (1.7mm isotropic, 1.5s TR), while participants viewed high-contrast checkerboard bars passing on a mean-luminance background. We systematically varied the spatiotemporal properties (bar speed and width) of the stimulus. Participants performed a dot-color-discrimination task at fixation. We show that divisive normalization pRFs parsimoniously explain both suppressive surrounds and compressive spatial summation, at a level consistently equivalent or above existing models. Furthermore, the divisive normalization pRF model includes new parameters that vary in biologically relevant ways, and lend themselves to interpretation in terms of neural baseline activity. For instance, we find that neural baseline activity varies systematically as a function of eccentricity. Divisive normalization pRFs provide a biologically-inspired, unified modeling framework for seemingly different properties of responses to spatial visual stimuli observed across the visual hierarchy. In addition to unifying previous pRF models, divisive normalization allows quantification of neural baseline activity. Estimating neural baseline activity has many potential applications in neuroscience, perception, attention, and clinical conditions.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you very much for your interest in this poster! We hope that you will join the scheduled video conference times and/or leave comments, questions, suggestions in the dedicated space. Thank you!

Abstract ID: 377

Differing mechanisms for contrast-dependent spatial frequency selectivity in macaque LGN and V1 neurons

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Paul Levy[1] (paul.levy@nyu.edu), Sach Sokol[1], Eero P Simoncelli[1,2], J. Anthony Movshon[1]; [1]Center for Neural Science, New York University, [2]HHMI, New York University

Neurons in the lateral geniculate nucleus (LGN) and primary visual cortex (V1) show contrast-dependent spatial frequency tuning: at low contrasts, they tend to prefer lower spatial frequencies. Proposed mechanisms include changes in the pooling properties of feed-forward filters, and the action of a recurrent, tuned gain control. It is unclear whether the cortical effects are computed de novo, or simply reflect the properties of thalamic input. We measured LGN and V1 responses to optimally-oriented sinusoidal gratings and grating mixtures presented at a range of contrasts. The mixture stimuli contained 3, 5, or 7 gratings at logarithmically-spaced spatial frequencies. We recorded well-isolated, single neurons in opiate-anesthetized paralyzed macaque monkeys. To test for linearity, we compared the response to grating mixtures with the summed responses to their components presented alone. Some cells' responses closely matched this linear prediction. Most cortical cells and magnocellular LGN cells were, however, sublinear. As expected from single-grating contrast response functions, the sublinearity was greater for mixtures whose components drove strong responses, and cells with strong saturation in the contrast-response function showed greater overall suppression to mixtures. We wondered whether this sublinearity was spatial-frequency dependent. V1 neurons show more nearly linear summation for mixtures at or above the peak frequency than for lower frequencies, an effect well captured by our previously proposed V1 model of frequency-tuned gain control. Summation in LGN neurons – even those with contrast-dependent tuning shifts – showed little frequency dependence. This suggests that the contrast dependence of V1 neurons is not inherited from their LGN afferents.

Acknowledgements: Simons Foundation and HHMI

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1579

Estimating scaling of retinal and cortical pooling using metamers

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

William Broderick[1] (billbrod@gmail.com), Gizem Rufo[2], Jonathan Winawer[1], Eero Simoncelli[1,3]; [1]New York University, [2]Facebook, [3]Howard Hughes Medical Institute

Human abilities to discriminate and identify many visual attributes vary across the visual field, and are notably worse in the periphery compared to the fovea. This is true of acuity, as well as more complex features or objects such as letters or faces. Statistical pooling models have been proposed as explanations for these variations (Balas et al., 2009). These models posit that the early visual system computes summary statistics that are locally averaged over pooling windows whose diameters grow in proportion to eccentricity. Here, we examine two pooling models over a wide field of view (FOV), one for retinal ganglion cells, which pools pixel intensity, and one for primary visual cortex, which pools local spectral energy, as measured with oriented receptive fields. To validate these models, we generate model “metamers”: stimuli that are physically different but whose pooled model responses are identical (Freeman & Simoncelli, 2011; Keshvari & Rosenholtz, 2016), and present them to subjects in a psychophysical experiment. The stimuli for both models are generated in a common computational framework that can be easily adapted to match a variety of image statistics within pooling windows. The synthetic stimuli have a large FOV of 82 by 47.6 degrees and a resolution of 3528 by 2048 pixels. We vary the model scaling values (the ratio between the pooling window diameter and eccentricity), testing values that are far lower than those previously reported (Freeman & Simoncelli, 2011, Wallis et al., 2019). Subjects are asked to discriminate pairs of synthesized images, as well as reference vs. synthesized images. Visual inspection of the images indicate that the threshold scaling values (at which the images become indistinguishable) for the two models differ by an order of magnitude, in rough correspondence with the receptive field sizes of neurons in the corresponding visual areas.

Acknowledgements: Facebook

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Supplementary info, including a transcript of the video and more example metamers, can be found here: https://osf.io/aketq/ (see README.md for description of contents)

Abstract ID: 1398

Extinguishing attention via transcranial magnetic stimulation

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Antonio Fernandez[1] (af3036@nyu.edu), Marisa Carrasco[1]; [1]New York University

[Goal] Orienting covert exogenous spatial attention to a target location improves visual performance in many visual tasks. The role of early visual cortical areas in such effects is largely unknown. Here, to establish a causal link between these visual areas and task performance, we used transcranial magnetic stimulation (TMS) to briefly disrupt cortical activity and determine whether early visual areas mediate the effect of exogenous attention on performance. [Methods] First, observers underwent TMS stimulation near the left occipital pole and drew the location of their perceived phosphene. Second, they performed an orientation discrimination task. Following a peripheral valid, neutral, or invalid cue, two cortically magnified gratings were presented, one in the phosphene region and the other in the symmetric region in the opposite hemifield. Observers received double pulse TMS while the stimuli were presented. Shortly after, a response cue indicated the target stimulus. Thus, the response cue either matched (target stimulated) or did not match (distractor stimulated) the stimulated side. Grating contrast was manipulated to measure contrast response functions for all combinations of attention and TMS conditions. [Results] Performance in the neutral condition was similar under both stimulation conditions. When the distractor was stimulated, as expected, exogenous attention yielded response gain: performance benefits at the high contrast levels in the valid-cue condition and costs in the invalid-cue condition compared to the neutral condition. In contrast, when the target was stimulated, the contrast response functions were similar; there was neither a benefit at the valid-cued location nor a cost at the invalid-cued location. [Conclusions] TMS eliminated both the benefits of exogenous attention at the attended location and costs at the unattended location. These results establish a causal link between early visual areas and the modulatory effect of exogenous attention on performance.

Acknowledgements: NIH R01-EY019693

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1395

Neural Correlates of Perceptual Filling-In as Measured by Functional Magnetic Resonance Imaging

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Yih-Shiuan Lin[1], Chien-Chung Chen[2,3], Mark W. Greenlee[1]; [1]Institute of Psychology, University of Regensburg, [2]Department of Psychology, National Taiwan University, [3]Neurobiology and Cognitive Science Center, National Taiwan University

Perceptual filling-in describes the phenomenon when our visual system replaces the central missing information with the surround features. We investigated such center-surround modulation by using functional magnetic resonance imaging (fMRI). Three radial sinusoidal grating stimuli were used in an event-related fMRI experiment: a full-field grating (center-surround), a filling-in grating with a crescent artificial scotoma in the periphery on each of the visual field (surround-only), and a pedestal grating containing radial pattern only in the scotoma locations (center-only). We doubled the trial number of the filling-in grating and adjusted the pattern luminance contrast for each observer until they perceived filling-in in about 50% of the trials, making it possible to compare the BOLD signal with and without reported filling-in. On each trial, one of the three gratings flickered in counterphase for 10 seconds, followed by a 14 seconds blank period. Observers were to press a button whenever the fixation point changed color, and to report whether filling-in was experienced during the presentation of the filling-in gratings. The functional regions of interest (ROIs) of the scotoma in the visual cortex (V1-3) were determined in an independent localizer session in which an on-and-off flickering checkerboard were presented in the "scotoma" location. The univariate analysis results showed no BOLD activation difference in the ROIs between the filling-in and non-filling-in trials, suggesting that the overall activation level did not correspond to the subjective percept. Interestingly, the BOLD activation was stronger in the pedestal condition compared to the full-field condition, indicating that adding the surround reduced the center activation. This finding supports that lateral inhibition was introduced from the surround. The multivariate pattern analysis (MVPA) results showed that response patterns in the visual cortex can significantly differentiate between filling-in and non-filling-in trials, suggesting that the neural activation pattern depends on the subjective percept of the observers.

Acknowledgements: Author YSL was supported by the German Academic Exchange Service (DAAD, Bonn Germany) in the form of a research grant for doctoral programs. Author CCC was supported by MOST 106-2410-H-002-074-MY2. Author MWG was supported by DFG grant number GR988 25-1.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

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ResearchGate: https://www.researchgate.net/profile/Yih_Shiuan_Lin

Abstract ID: 279

Neural representation of unconsciously predicted visual information in the visual cortex.

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

eunhee ji[1] (jieunhee01@gmail.com), Min-Shik Kim[1], Won Mok Shim[2,3]; [1]Department of Psychology, Yonsei University, [2]Department of Biomedical Engineering, Sungkyunkwan University, [3]Center for Neuroscience Imaging Research, Institute for Basic Science

Previous work on implicit working memory suggested that we can unconsciously extract the pattern of sequentially presented visual stimuli and predict a subsequent stimulus (Hassin et al., 2009). Here we examined how unconsciously predicted visual stimuli are represented in early visual areas. On each trial, when a grating was presented in one of four differently sized annuli, participants determined the orientation of a tilted bar at the center of the screen. Four gratings were presented sequentially one in each annulus, from outermost to innermost. In each presentation, the grating's orientation of was rotated by 30 degrees clockwise or counter-clockwise (continuous condition) or alternated between the two directions (discontinuous condition). In the regular pattern condition, the gratings were rotated following the predetermined rule; in the broken pattern condition, the fourth grating was rotated in the opposite of the predicted direction. As the participants' attention was drawn to the stimulus at the center throughout the trial, they were not aware of the changing grating pattern in the periphery. Using fMRI and inverted encoding models, we reconstructed population-level, orientation-selective responses to sequentially presented gratings in early visual cortices. We found that orientation-selective response in extrastriate areas (V2 and V3) elicited by the fourth grating were stronger in the regular pattern condition than in the broken pattern condition when the grating's orientation changed alternately between the two directions. However, the orientation response to the fourth grating did not differ between the regular and broken conditions when the grating's orientation changed continuously in one direction. These results suggest that unconscious predictions formed by implicit working memory could alter information processing in early visual area.

Acknowledgements: This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education (2018R1A6A3A01012610). This work is supported by IBS-R015-D1.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 961

Sparse adaptation among LGN neurons in the awake behaving primate

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Loic Daumail[1] (loic.daumail@vanderbilt.edu), Michele Cox[2], Jacob Westerberg[1], Blake Mitchell[1], Brock Carlson[1], Cortez Johnson[1], Paul Martin[3], Frank Tong[1], Alexander Maier[1], Kacie Dougherty[4]; [1]Vanderbilt University, [2]University of Rochester, [3]University of Sydney, [4]Princeton University

One of the most important functions of the visual system is to dynamically adapt to changing environments. A well-known neuronal phenomenon underlying such adaptation is a decline in visual response after prolonged or repeated visual exposure. Previous work suggests that visual adaptation in primates occurs primarily in the cortex. There is also evidence for limited pre-cortical adaptation. Specifically, single neuron recordings in anesthetized macaques revealed that adaptation induced by high-contrast gratings is exclusive to the magnocellular (M) cell class of the lateral geniculate nucleus of the dorsal thalamus (LGN). No such adaptation was found for the parvocellular (P) and koniocellular (K) cell classes. Here, we examine response adaptation among LGN neurons in awake macaques. Animals fixated on a computer screen while we presented drifting gratings of varying contrast for prolonged periods of time (>1s). While the animals performed this task we recorded visual responses of one or more of their LGN neurons using linear multielectrode arrays. We determined each unit's receptive field location as well as the cell subtype (M, P, or K) using cone-isolating stimuli and other physiological criteria such as the transience of the visual response and contrast response functions. We computed the decline of each unit's visual response across grating cycles. We found that although weak adaptation occurred in some M, P and K neurons, there was no significant adaptation at the group level. These results suggest that some effects of visual adaptation can be observed in the LGN of awake behaving primates, and that these effects are not limited to one class of LGN neurons. Nevertheless, in line with previous observations, we found that a substantial majority of LGN neurons do not show significant visual adaptation.

Acknowledgements: NIH-NEI grant: 1R01EY027402-03

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 863

Spatiotemporal dynamics of a nonlinear algorithmic primitive (XOR) in brain networks

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Katarzyna Jaworska[1] (katarzyna.jaworska@glasgow.ac.uk), Robin A A Ince[1], Nicola J van Rijsbergen[2], Philippe G Schyns[1]; [1]Institute of Neuroscience and Psychology, University of Glasgow, [2]Department of Psychology, Edge Hill University

A fundamental challenge in neuroscience is to understand where, when and how brain networks process information. Neuroscientists have approached this question partly by measuring brain activity in space, time and at different levels of granularity. However, rather than measuring brain activity per se, our aim is to understand the specific algorithmic functions that this activity reflects [1-3]. To address this, we studied the XOR primitive, a foundational algorithmic nonlinear function that returns “true” when only one of its inputs is true. To study this transformation in the brain, we manipulated the lenses of a pair of glasses presented to the left and right visual hemifield. Each participant (N = 10) responded “yes” when only one of the lenses was dark, while we recorded their brain activity with MEG (SupMat Fig 1, caption). Other participants performed AND (N = 9) and OR (N = 8) tasks on the same stimuli. We analyzed the spatiotemporal representation of the binary lens color (dark or clear) to find out where (i.e. which brain regions), when and how (i.e. in MEG voxel activity) each lens is individually represented vs. the two lenses are nonlinearly integrated for decision (SupMat Fig 2, caption). We performed this comparison per participant, on all cortical voxels, 0 to 300 ms post stimulus. Our analyses reveal the brain as a network of regions that initially (60-100 ms post-stimulus) linearly represents the left and right lenses in the lateral-occipital regions (SupMat Fig 2). Their critical nonlinear integration occurs later (200-300 ms) primarily in the right parietal-temporal cortices, with the explicit representation of XOR, AND or OR functions within the MEG activity (SupMat Fig 3). To conclude, we can start framing the brain as a network that performs specific algorithmic functions and start understanding the where, when and how of specific information processing.

Acknowledgements: This work has been funded by the Wellcome Trust (Senior Investigator Award, UK; 107802) and the Multidisciplinary University Research Initiative/Engineering and Physical Sciences Research Council (USA, UK; 172046-01) awarded to PGS

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 721

Statistical signatures of confidence can be misleading about the neural correlates of perceptual confidence

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Manuel Rausch[1] (manuel.rausch@ku.de), Michael Zehetleitner[1]; [1]Catholic University of Eichstaett-Ingolstadt, Eichstaett, Germany

Recent studies have traced the neural correlates of confidence in perceptual choices using statistical signatures of confidence. The most widely used statistical signature is the folded X-pattern, which was derived based on a Bayesian definition of confidence as the posterior probability of being correct. The folded X-pattern entails that confidence as the subjective probability of being correct equals the probability of 0.75 if the stimulus is neutral about the choice options, increases with discriminability of the stimulus in correct trials, and decreases with discriminability in incorrect trials. We present theoretical and empirical reasons why assuming the folded X pattern a priori may lead to inaccurate conclusions about the neural correlates of confidence. On theoretical grounds, we demonstrate analytically that Bayesian confidence in incorrect choices increases, not decreases with discriminability if observers obtain reliable trial-by-trial evidence about discriminability itself. Moreover, Bayesian confidence in choices about neutral stimuli is not .75 if discriminability is varied in discrete steps within the experiment. For the empirical reasons, confidence judgments were inconsistent with the folded X pattern in three different experiments, a masked orientation discrimination task, a random-dot-motion discrimination task, and a low-contrast number discrimination task. Finally, we demonstrate how reliance on the folded X-pattern leads to identify false neural correlates of confidence. In the masked orientation discrimination task, EEG recordings revealed that the Pe component at centroparietal electrodes 200 – 500 ms after participants' orientation judgments closely resembled the folded X-pattern. However, behavioural confidence matched neither the folded X-pattern nor the Pe component. Instead, confidence judgments were closely related to the P3 component recorded over centroparietal electrodes 300 – 500 ms after onset of the target stimulus. Overall, identifying neural correlates of confidence by presupposing a priori the folded X-pattern as the statistical signature of confidence is not legitimate.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 2:00 am EDT America/New_York
22 June, 8:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thank you for you interest ;-)
Please feel free to post comments and questions!

Contact: manuel.rausch@ku.de

In case you would like to have a closer look:
- Signatures paper: https://doi.org/10.1371/
journal.pcbi.1007456
- EEG paper: https://doi.org/10.1016/j.neuroimage.2020.116963

Abstract ID: 1058

Testing a two-stage model of stimulus selectivity in macaque V2

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Timothy D. Oleskiw[1] (oleskiw@nyu.edu), Justin D. Lieber[1], J. Anthony Movshon[1], Eero P. Simoncelli[1]; [1]New York University

As visual information propagates along the ventral pathway, individual neurons respond selectively to stimulus features of increasing complexity. Neurons in primary visual cortex (V1) respond to oriented gratings, while many neurons of the second visual area (V2) respond to more complex patterns, such as the pseudo-periodic structure of visual texture. Although V1 responses are well explained by receptive field models localized in space, orientation, and scale, it is unknown how a neuron in V2, receiving input from a subset of V1 afferents, achieves selectivity for the complex visual features common to natural scenes. Recently, we have shown that by computing differences between populations of V1-like units, V2-like units can become sensitive to higher-order statistics of natural texture, beyond the oriented energy (spectral) features relayed by V1. Here we test our theoretical predictions against single-unit recordings in areas V1 and V2 in an awake and fixating macaque. After characterizing a unit's receptive field using standard methods, we presented novel stimuli generated by superimposing patches of oriented gratings at multiple positions and scales. We fit a two-stage convolutional linear-nonlinear model to these responses: Stimuli are initially processed with a convolutional bank of V1-like filters selective for position, orientation, and scale. We then jointly optimize a linear-nonlinear combination of these rectified units to explain observed neural data. The model often explains a substantial fraction of response variance, comparable or superior to existing models. Qualitative differences emerge between models trained on V1 and V2 data. As expected, V1 models respond to a narrow range of position, orientation, and scale, whereas V2 cells often exhibit sensitivity to differences over stimulus position, scale, and orientation energy. By explicitly combining V1-like afferent activity, our two-stage model can explain V2's selectivity for higher-order stimulus features.

Acknowledgements: NIH EY022428, Simons Foundation, Howard Hughes Medical Instutue

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

All presentations will be held via zoom: https://nyu.zoom.us/j/4721503452
Contact oleskiw@nyu.edu to schedule an alternate time.

Abstract ID: 1540

The Ebbinghaus Illusion depends on Cortical Distance

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Poutasi Urale[1], D. Samuel Schwarzkopf[1,2]; [1]School of Optometry and Vision Science, University of Auckland, New Zealand, [2]Experimental Psychology, University College London, U.K.

In the Ebbinghaus Illusion, the perceived size of a circle (target) depends on the size and proximity of a surrounding circular arrangement of other circles (inducers). In most depictions of the illusion, inducers larger than the target make the target appear smaller while small inducers have the opposite effect. Although originally thought of as a size-contrast effect, strides have been made in understanding the mechanistic basis of this illusion. Converging evidence has suggested that it is driven by interactions between contours, which in turn may be mediated by cortical distance within primary visual cortex. Here we directly tested the effect of cortical distance on the strength of the Ebbinghaus Illusion by using a two interval forced choice design and an adaptive staircase procedure. In Experiment 1, we varied the physical distance between illusion components and found a progressive decrease in the perceived size of the target with greater physical distance both for large and small inducers. In Experiment 2, we applied a similar method using the Delboeuf Illusion, which is a size illusion like the Ebbinghaus Illusion that uses a ring annulus instead of circular inducers. We found an effect on illusion strength comparable to that seen in the Ebbinghaus illusion, supporting a common underlying mechanism. Finally, in Experiment 3 we predicted that due to lower cortical magnification in the peripheral visual field – and thus smaller cortical distances between illusion components – targets in the Ebbinghaus Illusion presented peripherally should appear larger compared to when they are presented centrally. We tested the illusion strength when positioning the stimuli at various eccentricities and our results supported this hypothesis. Taken together, results using two methods of manipulating cortical distance both point to cortical distance as a key mediator of the Ebbinghaus Illusion.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 225

Tri-polar EEG is well suited for the study of the visual system

Poster Presentation - *Topic area: Spatial Vision: Neural mechanisms*

Mackenzie V. Wise[1] (mackenziewise@nevada.unr.edu), Gabriel Foster[1], Erica Peterson[1], Gideon Paul Caplovitz[1], Michael A. Crognale[1]; [1]University of Nevada, Reno, Department of Psychology

Electroencephalography (EEG) is a staple of non-invasive neuroscience research that has been ubiquitously applied to the study of the visual system. Owing to the fact that EEG measures electrical-potential differences between distal locations on the scalp, the EEG signal is highly vulnerable to electrical artifacts. One approach for addressing this has been implemented through the development of tri-polar concentric ring electrodes (tCREs). tCREs measure potential differences across three circular conductive surfaces that together span up to no more that 10mm in diameter. These electrodes provide a neural correlate (tripolar-electroencephalography or tEEG) that is robust to far-field electrical artifacts. Here we assessed the suitability of tCREs and tEEG for the study of the visual evoked potential (VEP). We measured responses to visual stimuli commonly used in clinical and basic EEG settings using tCREs positioned at six posterior scalp locations. The tCREs were also used to simultaneously produce an emulated standard EEG signal (eEEG) allowing for the direct comparison of the tEEG. In 10 subjects, we compared pattern reversal VEPs measured in response to large (1º) and small (0.25º) checkerboards reversing polarity at 2hz, across seven fixation locations including central full-field stimulation. In all cases the tCREs were able to measure a high SNR pattern reversing VEP that showed comparable morphology to the classic pattern reversal VEP (i.e. N70, P100). We note subtle differences between the tEEG and eEEG waveforms including latency shifts in the N70 and P100 suggesting the tCREs measure common, yet not identical neural sources. We also had participants clench their jaws or chew rhythmically to produce large muscle artifacts. The tEEG VEP was much more robust in response to this behavior than the eEEG. Conclusion: tCREs and tEEG is a very promising alternative to classic EEG and is very well suited to the study of the visual system.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1412

Spatial Vision: Psychophysics, models, clinical

A response reclassification procedure to reduce noise caused by guesses

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Valerie Daigneault[1] (valerie.daigneault.2@umontreal.ca), Jean-Maxime Larouche[1], Laurent Caplette[1], Frédéric Gosselin[1]; [1]University of Montreal

Researchers studying cognition often rely on behavioral measures to uncover the underlying process behind correct and incorrect categorizations. However, these behavioral measures do not usually take into account the correct responses that are simply due to chance, which occurs when subjects guess. In a two-alternative discrimination task with a 75% correct response rate, for example, as much as 25% of all responses (or a third of all correct responses) are falsely correct. Here, we present a simple response reclassification procedure that reduces noise caused by false correct responses using response times (RT). The procedure determines, from the observed correct and incorrect RT distributions, a RT cutoff above which correct responses are relabeled as incorrect responses. To illustrate the procedure, we used two published datasets (Faghel-Soubeyrand & Gosselin, 2019; Royer et al., 2015) that employed Bubbles, a method relying heavily on response accuracy to reveal the information used to resolve a visual task. The standard weighted-sum computation applied to the reclassified accuracies led to a 15-20% increase in signal-to-noise ratio—equivalent to running between 32-44% more subjects—compared to the same computation applied to the recorded accuracies. A Matlab implementation of this reclassification procedure is freely available.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 920

Asymmetries around the visual field from retina to cortex

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Eline R Kupers[1] (eline.kupers@nyu.edu), Noah C Benson[1], Marisa Carrasco[1], Jonathan Winawer[1]; [1]New York University, New York

[BACKGROUND] Visual performance differs both as a function of eccentricity and polar angle. At isoeccentric locations, performance is better along the horizontal than vertical meridian (horizontal-vertical anisotropy, “HVA”) and better along the lower than upper vertical meridian (vertical-meridian asymmetry, “VMA”). Computational modeling shows that polar angle variations in optical quality and cone density can account for only a small fraction of polar angle variations in behavior (Kupers, Carrasco, Winawer, 2019). Here, we compare asymmetries around the visual field in cones, retinal ganglion cells, and visual cortex. [METHODS] We computed HVA and VMA as percent difference in cone density along cardinal meridia using two datasets (post-mortem, Curcio et al. 1990; adaptive optics, Song et al. 2011) in two analysis toolboxes (ISETBIO; rgcDisplacementMap), and in midget retinal ganglion cell density using two quantitative models (Watson, 2014; Barnett & Aguirre, 2018). Cortical asymmetries were computed from the Human Connectome Project retinotopy dataset (Benson et al., 2018) as percent difference in V1/V2 cortical surface area in ±10º wedges centered on the cardinal meridia. [RESULTS] For cone density, results are consistent across datasets and toolboxes: a constant ~20% HVA from 2–40º eccentricity, a slightly inverted VMA from 0–5º (denser in upper visual field), and no systematic VMA beyond 5º. The two models of mRGC density show a common general pattern: larger HVA and VMA than cones (at 3.5º, HVA: ~23–31%, VMA: ~15%), both of which increase with eccentricity (at 40º, HVA: ~60%, VMA:~50%). Cortical surface area asymmetries are yet larger than mRGC density asymmetries (at 3.5º, HVA: ~46%, VMA: ~46%, each increasing with eccentricity). [CONCLUSION] Asymmetries around the visual field are amplified from cones to mRGCs and from mRGCs to cortex. It will be important to implement computational models to test whether mRGCs and V1 asymmetries can quantitatively explain visual performance differences.

Acknowledgements: NEI R01 EY0274

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 270

Deep Neural Networks as a computational model for early vision: Lateral masking and contour integration

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Yoram Bonneh[1] (yoram.bonneh@gmail.com), Ron Dekel[2]; [1]School of Optometry and Vision Science, Bar-Ilan University, Israel, [2]Department of Neurobiology, Weizmann Institute of Sciecne, Israel

Background: The deep neural network (DNN) models developed for image classification have been recently suggested as biologically inspired models for different brain functions. Here we apply a standard visual DNN model to explore early-vision mechanisms of integration, as reflected in the psychophysical phenomena of lateral masking, contrast summation, and contour integration. Methods: We used the standard ImageNet-trained VGG network model. The model correlate of perceptual distance was the L2 distance between the average response to images corresponding to different stimuli conditions. Higher values of the metric (indicating larger changes in the DNN representation) correspond to better discrimination. Results: For lateral masking, the model produced a close match to the basic behavioral data (Polat & Sagi 1993), with a facilitation of ~0.4 log units at 2.5 wave-length distance, as well as: (1) inhibition for very close flankers, (2) no facilitation for orthogonal flankers and decreased facilitation with deviation from collinearity, (3) more facilitation of a vertical configuration compared to horizontal and oblique, (4) scaling of the effects with wave-length, and more. These results were obtained with a growing facilitation and longer interaction range from the mid layers of the model and up, indicating hierarchical integration that possibly substitutes for the assumed lateral interactions in V1. For contrast summation we replicated the configuration dependent (smooth but not jagged) summation (response vs number of patches along a Gabor contour) power-law (Bonneh and Sagi 1998). For Gabor contour detection in noise (Field et. al. 1993) the model showed the known effects of spacing, contour smoothness, and scaling. For noise detection in natural images (Alam et al. 2014), perceptual thresholds were strongly correlated with model predictions (R=0.78, N=1080 images). Conclusions: These findings demonstrate effortless replication in a DNN of classic findings concerning early human visual processing, suggesting convergent evolution of biological and artificial vision.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 4:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1356

Distinct patterns of foveal crowding for colour and motion in developmental amblyopia

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

John A. Greenwood[1] (john.greenwood@ucl.ac.uk), Kamilla Dombai[1], Siobhan M. Ludden[2], Annegret Dahlmann-Noor[2], Tessa M. Dekker[1]; [1]University College London, London, UK, [2]Moorfields Eye Hospital, London, UK

Crowding is the disruption to object recognition that arises in clutter. Though typically minimal in foveal vision, strong elevations occur during development and with amblyopia. Most theories depict crowding as a singular mechanism that disrupts the recognition of features ranging from colour to motion in the same way. We examined whether this prediction holds for the crowding of colour and motion in the amblyopic and developing fovea. Children aged 3-9 years with either typical vision (n=32) or strabismic amblyopia (n=24) were shown a foveal 'cowhide' target stimulus and judged its direction (left/right of upwards) or hue (blue/green) in a videogame context. Targets were presented either in isolation or crowded by 6 flankers, with stimulus sizes varied using QUEST to determine size-acuity thresholds. On average, typically-developing children showed similar thresholds for colour and motion with unflanked targets, and similar elevations when crowded. These elevations were however stronger for motion than colour in children below 6 years of age. For children with amblyopia, colour thresholds were matched with controls in the fellow eye, with an elevation in the amblyopic eye for unflanked thresholds and further elevation when flanked. In contrast, motion thresholds showed a binocular deficit – in the fellow eye, thresholds were considerably higher than colour for both unflanked and flanked targets. Further elevations were evident in the amblyopic eye, such that flanked motion judgements showed by far the worst performance. Altogether, amblyopic crowding causes a monocular pattern of disruption for colour perception, similar to that found with letter stimuli, whereas motion crowding exhibits a much stronger set of binocular elevations. Crowding is also stronger for motion than colour in young typically-developing children. These dissociations suggest that crowding is not a singular mechanism within the visual system, but rather that distinct features can be disrupted independently by clutter.

Acknowledgements: Funded by the UK Medical Research Council (MR/K024817/1).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Thanks for your interest in our work. Happy to discuss any questions by chat or via Zoom at the scheduled sessions (password is crowding20 for each one).

Copies of all our publications are available at http://eccentricvision.com

Abstract ID: 249

Ideal spatial summation is contrast dependent

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Chien-Chung Chen[1] (c3chen@ntu.edu.tw), Christopher Tyler[2]; [1]National Taiwan University, [2]Smith-Kettlewell Eye Research Institute

We investigated the mechanisms underlying spatial summation with a masking paradigm. The targets were Gabor patterns placed at 3-deg eccentricity to either the left or right of the fixation and elongated along an arc of the same radius. The mask was either a concentric (iso-orientation mask) or a radial (orthogonal mask) Gabor pattern embedded in a ring with the same 3-deg center radius. The observers indicated whether the target in each trial was on the left or the right of the fixation. The Ψ staircase procedure was used to measure the threshold at 75% accuracy. With either the orthogonal or the low contrast iso-orientation masks, the target threshold first decreased with size with slope -1 up to a target length of 45’ (half-height full-width; HHFW) and further decreased with slope -1/2 on log-log coordinates. The latter is the signature of an ideal summation process with local independent noise. With a high-contrast iso-orientation mask, the target threshold, while showing the -1 slope up to 45’ HHFW, remained constant from 45’ to 210’ HHFW, suggesting that the presence of the mask eliminated summation. Beyond 210’, however, masked thresholds further decreased with -1 slope, suggesting the existence of a highly elongated summation channel that is not revealed by a conventional spatial summation paradigm. Our results can be explained by a divisive inhibition model in which a second-order filter sums responses across the linear excitation of the local channels raised by a power, and is rescaled by divisive inhibition from all local image components. Such divisive inhibition from the high-contrast iso-orientation masks swamps the response and eliminates the target size effects for ideal summation. The decision variable is a nonlinear combination of the the second order filter and the elongated filter responses.

Acknowledgements: MOST(Taiwan) 108-2410-H-002 -105 -MY2

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 206

Integrating information across multiple observations in a visual detection task

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Zahra Hussain[1] (zahra.hussain@aub.edu.lb), Patrick Bennett[2]; [1]American University of Beirut, [2]McMaster University

Swets et al (1964) measured auditory sensitivity for narrow-band signals embedded in noise using a 4IFC detection task that contained five observations on each trial. They found that d’ increased with the square-root of observations when the noise varied across observations but not when the noise was the same. This result suggests that observers integrated information nearly optimally across the five observations. We report an experiment designed to test if this result held for visual detection. Ten observers performed a 2IFC detection task using band-limited textures in static white Gaussian noise. Each trial comprised five observations of a texture in variable or constant noise. Variable noise was independently sampled on both intervals of every observation in the trial (no two noise samples were identical). Constant noise was a fixed noise sample used for both intervals of all five observations in a trial. Noise conditions were blocked. Observers performed two sessions over two consecutive days, for a total of 800 trials (4000 observations) across days. Consistent with decision theory, d’ increased at a greater rate across observations in variable noise than in constant noise for the majority of observers. With some exceptions, d’ for each observer followed the square root prediction more closely for variable noise than for constant noise. When sensitivity was averaged across observers, d’ conformed to the square root prediction almost perfectly in variable noise, but levelled off after the second observation in constant noise. In addition, absolute performance in virtually all observers was better in variable noise than in constant noise across all observations. These results provide the first evidence, to our knowledge, of statistically optimal integration of information across observations in a visual detection task.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 570

Spatial frequency asymmetries around the visual field

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Shutian Xue[1], Antoine Barbot[1,2], Marisa Carrasco[1]; [1]New York University, [2]Spinoza Center for Neuroimaging

[Goal] At a given eccentricity, performance is better along the horizontal than the vertical meridian (horizontal-vertical anisotropy, HVA), and better along the lower than the upper vertical meridian (vertical meridian asymmetry, VMA). These performance fields are present in numerous visual tasks, including those mediated by spatial resolution. Here we investigated the extent of these spatial resolution asymmetries by measuring the HVA and VMA for spatial frequency (SF) sensitivity at different polar angles. Furthermore, to investigate the possible contribution of binocular disparity in performance fields, we assessed SF sensitivity both monocularly and binocularly. [Methods] We measured SF sensitivity at 24 isoeccentric (10º) locations. In each trial, four grating stimuli oriented ±45º appeared each at 4 locations separated by 90º polar angle. Observers reported the orientation of the target stimulus indicated by the response cue. The axis of the four isoeccentric locations was rotated across blocks to assess SF sensitivity every 15º polar angle. We obtained SF thresholds and cutoff points for each location and compared them under monocular and binocular viewing conditions. [Results] Lower SF thresholds and cutoff points were found in the lower than the upper visual hemifield. The extent of both HVA and VMA decreased linearly as the angular distance from the vertical meridian increased. This pattern of results was similar for binocular and monocular viewing conditions. [Conclusions] The HVA and VMA in SF sensitivity are most pronounced at the vertical meridian and decrease gradually, being no longer significant by the intercardinal meridia. Similar performance fields under monocular and binocular viewing conditions rule out differences in binocular disparity as a possible explanation. Consistent with findings showing a gradual decrease of these asymmetries for contrast sensitivity (Abrams, Nizam & Carrasco, 2012), our results indicate that comprehensive models of visual perception need to take into account the existence of performance fields.

Acknowledgements: NIH NEI R01-EY027401

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for your interest in our study. If you have any questions, feel free to bring it up during the conference session (zoom ID: 648 904 0554), in the chatbox, or contact me via email (sx712@nyu.edu).

Abstract ID: 116

Spatio-chromatic contrast sensitivity across the life span: interactions between age and light level in high dynamic range

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Maliha Ashraf[1] (maliha.ashraf@liverpool.ac.uk), Sophie Wuerger[1], Minjung Kim[2], Helen Saunderson[3], Jasna Martinović[3], Rafał Mantiuk[2]; [1]University of Liverpool, UK, [2]University of Cambridge, UK, [3]University of Aberdeen, UK

The purpose of our study was to investigate the difference in spatio-chromatic contrast sensitivity between younger and older colour-normal observers. We were particularly interested in how the adapting light level affected the contrast sensitivity and whether there was a differential age-related change in sensitivity. Contrast sensitivity was measured for three chromatic directions, luminance levels from 0.02 to 7000 cd/m^2, and different stimuli sizes using 4-AFC method on a HDR display. Stimuli were Gabor patches with fixed number of cycles and spatial frequencies of 0.5, 1, 2, 4, and 6 cpd displayed to 40 observers ranging from 21 to 74 years of age. Within each session, observers were fully adapted to the fixed background luminance. Our main findings are: (1) Contrast sensitivity increases with background luminance up to around 200 cd/m2, then either declines in case of luminance contrast sensitivity, or becomes constant in case of chromatic contrast sensitivity; (2) The sensitivity of the younger age group (<40 y.o.a.) is higher than that for the older age group roughly by 0.3 log units. This difference is roughly constant across colour directions and light levels. Only for the achromatic contrast sensitivity, the old age group shows a relatively larger decline in sensitivity for medium to high spatial frequencies at high photopic light levels; (3) Peak sensitivity and cut-off frequency of contrast sensitivity functions show decreasing trends with age and the rate of this decrease is dependent on mean luminance. We also collected qualitative data in focus groups, which showed that in relation to visual displays, older adults in general prefer bigger letter size and sharper edges. Both of these are consistent with altered processing at higher spatial frequencies. Older observers also tend to prefer higher contrast over saturation to an extent.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1286

Suboptimal visual averaging reveals compulsory nonlinear mechanisms in human vision

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Takahiro Doi[1] (doi.takah@gmail.com), Johannes Burge; [1]University of Pennsylvania

Computations that are suboptimal for laboratory tasks may help reveal the ecologically relevant tasks that perception may be optimized for. We examined how humans perform spatial averaging, a fundamental computation that is useful for integrating noisy local signals into more stable global estimates. We previously reported that human performance is substantially less accurate than the ideal observer in spatial averaging tasks in both the luminance and stereoscopic domains. In our tasks, the sample mean of the stimulus defines the correct choice, so the ideal observer computes its estimate from a simple average across the stimulus. Ideal observers without internal noise can perform the task without error. The observed patterns of human suboptimality could not be accounted for by fixed suboptimal receptive fields or simple forms of internal noise. Indeed, humans made consistent errors across repeated presentations of identical stimuli that could only be explained with nonlinear mechanisms. Here, we examine the nature of these nonlinearities, and determine whether they are sensitive or insensitive to spatial patterns in the stimuli. In two double-pass experiments, human observers judged the average luminance or average stereoscopic depth of nine adjacent horizontal bars relative to a reference surface. In the first experiment, observers responded to repeated presentations of identical stimuli. In the second experiment, observers responded to repeated presentations that were spatially shuffled. Across three observers in both the luminance and stereoscopic tasks, spatial shuffling reduces choice consistency by 60% on average. Thus, both pattern-insensitive and pattern-sensitive nonlinearities are at work. The pattern-insensitive nonlinearity implements a form of outlier down-weighting; the pattern-sensitive nonlinearity encodes the spatial interaction among nearby signals. These compulsory nonlinear mechanisms, while suboptimal in our laboratory task, may reflect an integration strategy that improves performance in more natural contexts cluttered with object boundaries and illumination variation.

Acknowledgements: This work was supported by NIH grant R01-EY028571 from the National Eye Institute & the Office of Behavioral and Social Science Research.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thanks for coming to my virtual presentation! Please feel free to email me any comments and questions. I will appreciate it!

Abstract ID: 1404

The Human Visual System Whitens in Space But Not in Spatial Frequency

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Anqi Zhang[1] (anqizhang@utexas.edu), Wilson S. Geisler[1]; [1]Center for Perceptual Systems, University of Texas-Austin

Identifying objects in natural backgrounds is a significant natural task for human and primate visual systems. Natural backgrounds (and medical image backgrounds) typically modulate in contrast over space, and have amplitude spectra that fall inversely with spatial frequency. The effect of these two properties of natural backgrounds can be studied by measuring and modeling thresholds for identifying targets in contrast-modulated 1/f noise. In this task, the ideal observer computes the response of a template ("receptive field" in the shape of the target) that is weighted (whitened) in the Fourier domain by the inverse of the power spectrum, and is weighted (whitened) in the space domain by the inverse of the local contrast power. Whitening in spatial frequency capitalizes on the variations in the background's amplitude spectrum across spatial frequency; whitening in space capitalizes on the variations in the background's contrast across space. Suboptimal models include applying (a) a template that is whitened neither in spatial frequency nor space (the ideal observer for detection in white noise), (b) a template that is only whitened in spatial frequency (the ideal observer for detection in 1/f noise), and (c) a template that is only whitened in space (the ideal observer for detection in modulated white noise). In simulations, we determined the identification thresholds of the optimal and suboptimal models for spatially-windowed periodic targets that varied in spatial frequency content (sine wave, triangle wave, square wave, and rectangle wave). Whitening in spatial frequency is least beneficial for the sine wave target, and most beneficial for the rectangle wave, and this benefit holds for uniform and contrast modulated 1/f noise. Whitening in space is equally beneficial for all targets, but only in modulated noise. Preliminary measurements on human subjects are most consistent with model (c), where the template is only whitened in space.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

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Abstract ID: 425

The role of GABA during visual contrast perception in psychosis

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Michael-Paul Schallmo[1] (schal110@umn.edu), Hannah R. Moser[1], Caroline Demro[1], Małgorzata Marjańska[1], Scott R. Sponheim[2,1]; [1]University of Minnesota, [2]Minneapolis VA Medical Center

People with psychosis experience abnormal visual percepts (e.g., hallucinations), and have shown reduced sensitivity to visual contrast. Although the neural basis of psychotic disorders such as schizophrenia remains unknown, a prominent theory suggests impaired GABAergic inhibitory functioning. We investigated the role of inhibition in the visual system of people with psychosis using ultra-short echo time (8 ms) STEAM MR spectroscopy at 7 tesla, and a visual contrast discrimination task performed outside the scanner. Data were acquired from 41 participants with psychosis, 25 unaffected biological relatives of participants with psychosis, and 33 healthy controls as part of the Psychosis Human Connectome Project. Participants with psychosis showed impaired discrimination across all pedestal contrasts, but we saw no difference in mid-occipital GABA levels between groups. Across all participants, we found that higher GABA levels were correlated with reduced visual contrast discrimination (higher thresholds). In particular, we found that GABA levels correlated with thresholds for low (< 2%) but not higher (≥ 5%) contrast stimuli. Our findings suggest that higher resting GABA levels in visual cortex may inhibit perception of visual stimuli based on luminance contrast in both people with and without psychosis. Previous observations of lower occipital GABA levels among people with psychosis might be explained by differences in either transverse relaxation time (T2) and / or macromolecular content between groups, as we sought to control for these effects in our MRS results.

Acknowledgements: U01 MH108150, P41 EB015894, P30 NS076408

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 340

The test-retest reliability and spatial tuning of serial dependence in orientation perception

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Aki Kondo[1,2,4], Yuki Murai[1,3,4], David Whitney[1]; [1]University of California, Berkeley, [2]Kyoto Institute of Technology, [3]Osaka University, [4]Japan Society for the Promotion of Science

Although visual input is noisy and unreliable, we can perceive the identities of objects as stable and continuous. The mechanism contributing to this perceptual stability is called serial dependence, and it has been reported that the perception of stimulus features are assimilated toward stimuli presented in previous trials. Whereas the serial dependence has been reported for a variety of stimuli, the underlying mechanism remains unclear. In a previous study, we examined the correlation between individual differences in perceptual serial dependence for orientation and working memory capacity in order to determine whether serial dependence requires working memory, but no significant correlation was found between them across subjects (Zhang and Whitney, VSS2017). Here, we investigated the spatial tuning of perceptual serial dependence by examining whether the individual differences in orientation serial dependence are distinct for foveal and peripheral vision. In addition, we also examined serial dependence for orientation over two different days for the same subjects to confirm the stability of perceptual serial dependence. On each trial, subjects viewed Gabor patches and reported the perceived orientation of each Gabor by adjusting the orientation of a bar. For each subject, the Gabor's position was in the foveal or peripheral (10° eccentricity) visual field on both days or changed from day to day. The results showed that the assimilation effect toward the 1-back trial was significantly correlated in both foveal (r=.76) and peripheral vision (r=.77), even though they were measured on different days. Interestingly, these high within-subject correlations were also found when the assimilation effect was examined with foveal and peripheral vision on different days (r=.71). These results suggest that visual serial dependence is not mediated by separate systems in foveal and peripheral vision, but by a continuity field operator with broad spatial tuning that could facilitate perceptual stability of orientation information over time.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 793

Visual contrast processing in people with psychosis

Poster Presentation - *Topic area: Spatial Vision: Psychophysics, models, clinical*

Hannah R. Moser[1], Li Shen Chong[1], Marisa J. Sanchez[1], Scott R. Sponheim[2,1], Michael-Paul Schallmo[1]; [1]University of Minnesota, [2]Minneapolis VA Medical Center

People with psychosis commonly experience abnormal visual perception characterized by clinical symptoms (e.g. hallucinations) as well as differences in performance on various psychophysical tasks. These differences in perceptual experience are present across different diagnoses involving psychosis and are related with disease severity and outcomes, yet the underlying neural processes are not well understood. As part of the ongoing Psychosis Human Connectome Project, this study was designed to examine differences in visual contrast processing in people with psychotic disorders including schizophrenia, schizoaffective disorder, or bipolar disorder. Behavioral and 7 tesla fMRI data were acquired during visual contrast detection tasks in 35 people with psychosis, 25 unaffected first-degree biological relatives, and 20

healthy controls. In experiments performed outside the scanner, a psychophysical adaptive staircase method was used to determine contrast discrimination thresholds at seven contrast pedestals. Thresholds were defined by the minimum difference in contrast between two stimuli that participants could discriminate with 80% accuracy. During a similar contrast discrimination task, fMRI responses were measured in primary visual cortex. People with psychosis exhibited increased visual contrast discrimination thresholds as compared to relatives or controls. There were no differences in visual contrast discrimination thresholds between diagnostic groups, suggesting that this difference in visual perception is not associated with a specific diagnostic phenotype. Behavioral data were fit with a contrast response function in order to model a predicted neural response for each participant group. Estimated slope parameters differed between relatives and controls, predicting a steeper contrast response for people with a genetic liability for psychosis. Accordingly, contrast-dependent fMRI responses in primary visual cortex exhibited differences in slope across groups. These data suggest that contrast perception is impaired across the psychosis spectrum, which may be related to abnormal neural processing within early visual cortex.

Acknowledgements: U01 MH108150, P41 EB015894, P30 NS076408

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 406

Spatial Vision: Textures, ensembles, figure ground

A distinctive role for orientation in figure-ground separation

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Jonathan Victor[1] (jdvicto@med.cornell.edu), Mary Conte[1]; [1]Weill Cornell Medical College

Figure-ground separation can be driven by differences in luminance, contrast, orientation, and other local cues. In natural scenes, these multiple cues are intertwined. To probe how they interact, we constructed a space of synthetic textures in which these cues could be separately manipulated (Vision Res. 2015). We used these textures to create images in which the cues that defined figure and ground were varied independently. We then asked whether figure-ground separation is driven simply by the difference between figure and ground, or rather, whether the compositions of figure and ground also play a role. We focused on textures defined by their second-order statistics, as these contained both contrast and orientation information. Four orientations (cardinal and oblique) were studied. Subjects (N=3) carried out a 2-AFC task, identifying a target image that contained five randomly-positioned circular figures (25% of the total area) defined by one set of local image statistics, superimposed on a background defined by a different set of image statistics. The non-target image was statistically uniform, and matched the target image's statistics averaged across space. Thresholds for figure-ground separation depended not only on the figure-ground difference, but also on their individual contents. However, the balance of these factors depended on the extent to which the textures were oriented. For textures that were blob-like (e.g., positive correlations on both horizontal and vertical axes), only the figure-ground difference mattered. For textures that were strongly oriented (e.g., positive correlations on the horizontal axis but negative correlations on the vertical axis), the composition of figure and ground had a large effect, influencing threshold by up to a factor of two even when figure-ground differences were held constant. In sum, figure-ground separation makes use not only of texture differences, but also of the orientation composition of figure and ground.

Acknowledgements: NIH EY07977

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 8:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 112

Ensemble Perception during Multiple Object Tracking

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Reem Alzahabi[1] (reem.alzahabi@tufts.edu), Matthew Cain[1]; [1]Tufts University, Center for Applied Brain and Cognitive Sciences

Multiple object tracking studies consistently reveal attentive tracking limits of approximately 3–5 items (Pylyshyn & Storm, 1988). In addition, we know of several cognitive phenomena that are subject to changes in processing due to grouping, such as improvements in visual working memory (Li, Qian, & Liang, 2018). Yet, there has been little systematic work investigating the role of grouping on multiple object tracking ability, and more specifically, in identifying the heuristics that lead to the formation and perception of ensembles within dynamic contexts. The current study addresses the following questions: (1) Is tracking

capacity impacted by the number of items the group is composed of? (2) To what extent do inter-object spacing and common fate contribute to the perception of moving groups of objects? (3) Does the perception of common fate rely on the rigidity of the group? That is, to what extent can the individuated objects within a group deviate from the group's overall motion and the group still be perceived as a group? In experiment 1, we manipulated group size (2, 4, or 8 objects) and tracking load (4– 32 objects) and found that tracking capacity estimates were on average, 4 groups of objects, regardless of the number of items a group is composed of. In experiment 2, we manipulated inter-object spacing, while maintaining a constant common fate trajectory. We found that tracking performance declined as inter-object spacing increased. In experiment 3, we manipulated the jitter of individual objects within a group, such that eccentricities of movement spanned increasing distances. We found that tracking performance declined as jitter eccentricities expanded and common fate was increasingly disrupted. Our data contribute to our overall understanding of multiple object tracking as it applies to groups of objects and characterizes the properties that determine the formation and perception of object ensembles.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 122

Further Evidence that Probability Density Shape is a Proxy for Correlation

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Madison Elliott[1] (mellio10@psych.ubc.ca), Ronald Rensink[1]; [1]University of British Columbia

Previous work demonstrated a discrimination performance cost for selecting “target” correlation populations among irrelevant “distractor” populations in two-class scatterplots (Elliott, 2016). This cost cannot be eliminated by increasing featural differences, e.g., color, between the dots in the two populations (Elliott & Rensink, VSS 2018). These findings do not agree with predictions from feature-based attention models (Wolfe, 1994), motivating us to investigate whether feature information can in fact be used to select target correlation populations. Observers performed a correlation discrimination task for scatterplots containing a target and a distractor population. Both populations had the same mean, standard deviation, color, and number of dots; the resulting two-class plots were distinguished by the correlation of the target population only. In the first of two counterbalanced conditions, targets were more correlated than the distractors; in the second, they were less. Results showed that observers can successfully

discriminate two-class plots based on the correlation of their target populations. Increased JNDs were found when targets had higher correlations than distractors, replicating the results of Elliott (2016); however, there was no cost for targets with lower correlations. This asymmetry supports the proposal (Rensink, 2017) that estimation of correlation in scatterplots is based on the width of the probability density function corresponding to the dot cloud; for a two-class plot this appears to be a single density function dominated by the width of the lower-correlation (and thus wider) population. In addition, there is a resistance to feature selection: performance is the same regardless of the difference in features between target and distractor populations. This suggests that a two-class scatterplot is coded as a single ensemble, with observers unable to select items based on the value of their features because ensemble structure is prioritized over item-level feature information (Brady & Alvarez, 2011).

Acknowledgements: UBC 4 Year PhD Fellowship

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Ask me for a copy of our paper pre-print!

Abstract ID: 1481

Image predictors of visual localization in natural scenes

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Anna Kosovicheva[1] (akosov@northeastern.edu), Koushik Sridhar[1,2], Peter J Bex[1]; [1]Northeastern University, [2]North Carolina School of Science and Mathematics

Accurate visual localization is essential for our ability to interact with the world. Previous work has shown that the perceived location of an object is influenced by its surrounding context (e.g., frames of reference, landmarks, motion), but less is known about which image statistics influence localization errors within natural scenes. We measured the influence of local image statistics (luminance, edges, object boundaries, and saliency) on perceptual reports of location. On each trial, 10 observers reported the location of a brief (50 ms) Gaussian target (σ=0.85º) superimposed on a 48º by 37º photograph of a natural scene at one of three eccentricities (5º, 7.5º, 10º) and one of 24 angular locations. Observers reported the target's perceived location by adjusting the position of a cursor. For each statistic, we calculated the difference between the image value at the physical center of the Gaussian target and the value at its reported center, and averaged the resulting difference scores across 720 trials. To isolate image-specific effects, these difference scores were compared to a randomly-permuted null distribution, that was calculated by shuffling the mapping between the response coordinates and different images across all trials. The

observed difference scores indicated that responses were significantly biased toward darker regions, luminance edges, object boundaries, and areas of high saliency (p-values <. 001; αB = .006), with low shared variance between these measures (R2 < .02). In a second experiment, 12 observers made reflexive saccades to the same targets. The results showed that the same image statistics were associated with observers' saccade errors, despite large differences in reaction time for the two experiments (987 vs. 239 ms). Together, these results indicate that local spatial statistics influence localization in natural images, and that these biases are independent of response modality.

Acknowledgements: This work was supported by funding from the National Institutes of Health (R01 EY029713 to P. J. B. and F32 EY028814 to A. K.).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 183

Interactions between different visual features in the ensemble perception of size

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Hoko Nakada[1] (hoko@g.ecc.u-tokyo.ac.jp), Ikuya Murakami[1]; [1]Department of Psychology, University of Tokyo

It is widely known that the visual system is able to extract summary statistics from a group of multiple objects sharing a certain visual feature. Although a lot of studies have examined various kinds of ensemble perception, such as average size, hue, motion direction and speed, it remains to be clarified how these summary statistics are calculated within a single feature or across different features. Here, we focused on the average size of an array of circles, which is known to be perceived accurately even for very brief displays, and investigated whether the perceived average size of circles having a particular distinct feature was affected by the average size of distractors, namely circles having another distinct feature. Observers were presented with an array of blue circles arranged on the left and right sides of the display and made a two-alternative forced-choice judgment about which side contained blue circles with the larger average size. Each side also contained an array of green circles with one of three average sizes. Parameters were set so that shifts in psychometric functions should mean that the average size of the ignored green circles affected the perceived average size of the blue circles. We also did another experiment by exchanging the

roles of these two colors, namely green to be focused on and blue to be ignored. The results showed asymmetry between blue and green. Averaging of blue circles was not affected by green distractors, whereas averaging of green circles was affected by blue distractors, such that an array of green circles accompanied by blue distractors with a larger average size was judged as having a larger average size. These results indicate compulsive contribution from distractors in rapid ensemble perception of size and suggest that the perceptual distinctiveness of color plays a key role.

Acknowledgements: Supported by KAKENHI 18H01099

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 983

Judgments of average and variance within object ensembles rely on a common ability

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Oakyoon Cha[1] (oakyoon@gmail.com), Randolph Blake[1], Isabel Gauthier[1]; [1]Vanderbilt University

Visual estimation of statistical properties can help us grab the ‘gist’ from a group of objects while discounting redundant information. For instance, we say “green leaves” to describe leaves whose color is generally (i.e., on average) green, and “colorful fall leaves” to describe the color variation for a group of leaves. Abilities to judge averages correlate among low-level features (color and orientation; Haberman, Brady & Alvarez, 2005) and among objects from different categories, suggesting that average estimation relies on common abilities for visual features of similar complexity. In contrast, prior work has concluded that abilities to judge different statistical summaries (e.g., average and variance of size) are uncorrelated (e.g., Yang, Tokita, & Ishiguch, 2018). That work however suffers from limitations. First, claims about the absence of correlation were based on small samples. Second, estimates of common variance across tasks did not control for participants’ discrimination abilities with single items. Third, the estimation tasks differed for different statistical summaries being estimated. Here, in a sample of 97 participants, we measured performance in judging: i) the size of a single circle, ii) the size variance within an array of six circles, and iii) the average size within an array of six circles. In our versions of both estimation tasks, participants compared two arrays of circles presented sequentially and judged which array had more variance or a larger average size. We calculated the partial correlation between performance on the

average and on the variance estimation tasks, controlling for participants' discrimination abilities in judgments with single circles. We found that average and variance estimation abilities for the same objects were positively correlated. These results suggest involvement of a common mechanism for ensemble processing of different statistical summaries, over and above perceptual abilities relevant to judgments about single objects.

Acknowledgements: This work was supported by the Centennial Research Fund (Vanderbilt University) and by the David K. Wilson Chair Research Fund (Vanderbilt University).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 841

Naturalistic texture perception relies preferentially on high spatial frequencies

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Justin D. Lieber[1] (justinlieber@nyu.edu), Gerick M. Lee[1], Najib J. Majaj[1], J. Anthony Movshon[1]; [1]New York University

Human observers can effortlessly tell the difference between natural images and randomly generated noise. Some elementary statistical features that distinguish natural images can be captured in "naturalistic texture" images generated by a method devised by Portilla & Simoncelli (2000). These textures are easily distinguishable from randomly generated images with identical spectra, but it is unclear what features drive this perceptual sensitivity. We wondered whether certain frequency bands are particularly important for naturalness perception. We created families of images that span the range from fully naturalistic textures to spectrally matched "noise." Suitably combined, these create images with naturalistic structure limited to one of three spatial frequency bands: a low-pass spatial frequency band, a high-pass spatial frequency band, or the full spatial frequency spectrum. This allowed us to test how well an observer could discriminate the presence or absence of naturalistic structure, using a three-alternative forced-choice oddity task. As a control, we also had the observer perform a contrast discrimination task using the same base images, but now discriminating the presence or absence of contrast steps within the same low, high, and all-pass spatial frequency bands. Contrast discrimination was more strongly impaired by the removal of low-frequency contrast steps than of high-frequency steps. Conversely, performance in the texture

discrimination task was largely robust to the removal of low-frequency naturalistic structure. These results suggest that our perception of image naturalness may rely on higher spatial frequency bands than those for which contrast sensitivity is highest. The prominent role of high-frequencies in texture discrimination may help explain a recently described deficit in texture sensitivity observed in amblyopic patients (Lee et al. 2017, SfN Meeting Abstract), who typically lack sensitivity to high spatial frequencies.

Acknowledgements: NIH R01EY022428

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for coming by. If you'd like to chat about the poster and can't make any of the presenter conference times, feel free to shoot me an email at justinlieber (at) nyu (dot) edu, and we can find another time to talk. I'm also happy to answer any questions over email.

Abstract ID: 1509

Orientation averaging of skewed distributions: behavioral study and computational model

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Aleksei Iakovlev[1], Igor Utochkin[1]; [1]National Research University Higher School of Economics, Russia

Research in ensemble perception has documented that people can calculate the mean of a feature distribution with relatively high precision. How do we calculate that “mean”? Whereas some models assume that the visual system simply averages a subsample items, other models based on population coding (Haberman & Whitney, 2012; Hochstein, VSS 2018) suggest that the “mean” is represented as a peak response or vector sum of a neural population response to all items. Recently, Utochkin (ECVP 2019) has proposed a hypothetical model of ensemble coding based on population coding by neurons with large receptive fields that pool local feature signals from lower-level populations with smaller receptive fields. The activation profile of this pooled response, with a “central tendency” peak, inherently results from tuning curves of pooling neurons reflecting the distribution of synaptic weights of the local signals. Our computational implementation of this pooling+population coding model predicted that in ensembles with skewed feature distributions, the peak of a population response would shift away from the physical mean of a distribution toward its mode. The larger the skew, the larger the shift of the peak is predicted. To test this prediction, we asked participants to adjust the mean orientation of 25 triangles. We varied the skew of an orientation distribution and measured the systematic deviation of mean orientation estimates. We

found that the estimates followed this prediction. Importantly, the amount of bias away from the physical mean showed excellent fit (R^2 = 0.99) to a model based on realistic tuning properties of broadly-tuned V4 orientation-selective neurons (McAdams & Maunsell, 1999). We conclude, therefore, that pooling+population coding in higher-level visual areas can be a plausible neural mechanism of ensemble averaging and that V4 neurons can be potentially involved in ensemble encoding for orientation.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 356

Orientation variability is represented as the weighted standard deviation

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Jinhyeok Jeong[1], Sang Chul Chong[1]; [1]Yonsei University, Seoul, Republic of Korea

When confronted with many visual items, people can represent the variance of them accurately and rapidly. However, how the visual system computes the variance remains unclear. To investigate this, we examined which of the variability measures such as the range, standard deviation, and weighted standard deviation could account for variance perception better. Participants watched two Gabor arrays of various orientations and judged which array was more heterogeneous. In Experiment 1, we manipulated orientations except those near the extreme orientations to change the standard deviation while keeping the range constant. Results showed that even when two arrays had similar ranges, the perceived variance was higher for the array with a larger standard deviation, indicating that people represent the variance using the standard deviation rather than the range. In Experiment 2, we manipulated the deviance of extreme orientations to change the range of orientations while the standard deviations were kept similar across conditions. We found that even when two arrays had similar standard deviations, the perceived variance was smaller for the array of a wider range with a few extreme orientations. It indicates that people consider extreme orientations less than others when computing the standard deviation. In Experiment 3, we increased the contrast of orientations either near the mean or the extreme orientation of the set so that they were more salient than the rest. Although the actual range and standard deviation of the orientations were constant across conditions, the perceived variance was higher when salient orientations

were near the extreme orientation than when they were near the mean, indicating that people consider salient orientations more than others when computing the standard deviation. In summary, these results suggest that people compute the weighted standard deviation by considering some items more or less than others to represent orientation variance.

Acknowledgements: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (NRF-2019R1A2B5B01070038)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 480

Overestimation of Variability in Ensembles of Line Orientation, Size, and Hue

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Amelia C. Warden[1] (acwarden@colostate.edu), Jessica K. Witt[2], Mengzhu Fu[3], Michael Dodd[4]; [1]Colorado State University, [2]University of Nebraska at Lincoln

Ensemble perception utilizes our visual system's natural abilities to extract summary statistics from sets of similar objects. Our perceptual system can accurately detect the mean of these ensembles. However, previous research has shown that our visual system is biased to overestimate variability. This bias to overestimate variability was stronger when the objects were more similar to each other. This prior research concerned variability of line orientations. We extended this work to explore whether this overestimation bias is a general phenomenon and therefore applies to other visual features as well. Using the method of adjustment, participants made judgments about the variability of line orientation, size, and hue in sets of ensembles (lines and circles). Participants viewed 9 target circles of various sizes presented one-at-a-time, then adjusted the sizes of five comparison circles presented simultaneously to match the variability in the target display. A similar task was used to assess how participants estimated variability in line orientation and hue. Participants overestimated variability, and this was true for all 3 features. Moreover, participants overestimated variability to a greater extent when there was less variability in the display for circle size (95% overestimation), line orientation (51% overestimation), and hue (155% overestimation) compared to high levels of variability (-11%, -10%, -3%, respectively). Understanding how we perceive variability in ensembles is essential when making judgments about critical information in medical images. For instance,

how distributed calcifications are within a mammogram informs whether a radiologist diagnoses a patient with cancer. Further research will attempt to elucidate the mechanisms of ensemble perceptual and test the robustness of the bias to overestimate variability.

Acknowledgements: National Science Foundation

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1240

The Set Size Bias in Ensemble Comparison (Or Why Showing Raw Data May Be Misleading)

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Steve Haroz[1]; [1]Inria, Université Paris-Saclay

Ensemble perception is characterized by the rapid ability to estimate a summary statistic from a set without needing serial inspection. But which stimulus properties influence how that summary is made? In a within-subject experiment with per-trial feedback, subjects chose which set had a larger average value. Using data visualizations as stimuli, subjects were asked which of two sets had a higher position (dot plots), a larger size (floating bar graphs), or redundantly coded highest position and largest size (regular bar graphs). The experiment also varied set size (1vs1, 12vs12, 20vs20, 12vs20, and 20vs12), mean difference between the sets (0 to 80 pixels in 10 pixel increments), and which set had the largest single value. With 25 repetitions per condition, each subjects ran in over 5,000 trials. For single-item comparisons, position was unsurprisingly more precise than length alone. However, for set comparison, the noisiness of ensemble coding appears to overpower these differences, so position, length, and the redundant combination have indistinguishable discriminability, which contradicts Cleveland & McGill (1984). Moreover, for all visual features, responses were biased towards the larger set size. Previous results (Yuan, Haroz, & Franconeri 2018) suggested that this bias is caused by estimating a sum or total area. But because the effect occurs in the position (dot plot) condition, where sum or total area are unhelpful, that model is unlikely. Additional analyses did not reveal a bias towards the set with the largest single value, the smallest single value, or the largest range of values. These results imply that this bias is holistic and not driven by simpler proxies. As showing raw data rather than only summary statistics is common advice in visualization design, the set size

bias could cause people to misinterpret visualizations that do not have the same number of items in each group.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

I am available via zoom or gchat any time during the conference.

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A demo version of the experiment with a small number of trials. Mouseover to cheat.
http://steveharoz.com/test/compare_experiment/?feedback&maxsetsize=20&mturk=0&debug

How to run 5k trials/subject on Prolific. Happy to answer more questions about this.
http://steveharoz.com/public/vss/Haroz_-_VSS2020_-_5k_trials.pdf

Abstract ID: 741

The effect of practice on response bias in a visual detection task

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Patrick J. Bennett[1] (bennett@mcmaster.ca), Zahra Hussain[2]; [1]McMaster University, [2]American University of Beirut

We examined how practice alters response bias in a yes-no visual detection task. Observers detected band-limited textures in two levels of static white Gaussian noise over two consecutive days. Half of the observers saw the same textures on day 2 and half saw novel textures. The textures on signal-present trials were presented at several contrasts using the method of constant stimuli: signal-present and signal-absent trials were equally likely. The data were used to estimate global and local response criteria. The global criterion (Jones et al, 2015) was defined using hit rates at all contrasts, whereas local criteria were measured for the two contrasts corresponding to hit rates of 70% and 80% on Day 1 (Wenger and Rasche, 2006). Sensitivity in both groups of observers increased across days. We also found that practice had small effects on response bias: on average, observers made fewer false alarms on Day 2 than Day 1. For the global measure of criterion, this shift in response bias meant that observers were, on average, closer to the

criterion that maximized the percentage of correct responses. The effects on the local measures of criterion were more variable across groups and noise levels. In summary, practice shifted the response criterion in a direction that reduced false alarms and increased response accuracy.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1326

Visual statistics of aquatic environments in the natural habitats of zebrafish

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Lanya T. Cai[1], Venkatesh Krishna[2], Tim C. Hladnik[3], Nicholas C. Guilbeault[2], Scott A. Juntti[4], Tod R. Thiele[2], Aristides B. Arrenberg[3], Emily A. Cooper[1]; [1]University of California, Berkeley, CA, USA, [2]University of Toronto Scarborough, Canada, [3]University of Tuebingen, Germany, [4]University of Maryland, College Park, MD, USA

According to the efficient coding hypothesis, animals' visual systems are adapted to exploit the regularities of natural environments so as to encode maximal sensory information with minimal metabolic cost. The visual regularities of natural environments can be characterized empirically through large image or video datasets. While common visual features have been discovered in the study of these datasets, different environments and contexts also contain reliable statistical differences. Thus, to evaluate the efficiency of a model animal's visual system, one must characterize the statistics of the animal's specific habitat. Zebrafish have become a popular model in visual neuroscience due to their amenability to advanced research tools and their diverse set of visually-guided behaviors. However, little is known about the spatiotemporal features of the habitats where zebrafish reside. To address this gap, we collected and analyzed a video dataset of the aquatic environments in northeastern India where zebrafish are native. We obtained this dataset from an omnidirectional high-frame-rate video camera, which was mounted to a robot that captured stationary viewing and simulated swimming behaviors. Similar to previous work on both atmospheric and aquatic natural images, we found that the spatial power spectra of these environments fell off approximately exponentially as a function of frequency. However, we found that the temporal power spectra were less monotonic than expected from atmospheric counterparts. Reduced monotonicity can be attributed to power bumps at mid-range temporal frequencies associated with high-contrast and dynamic rippling patterns underwater. Our results suggest that the demands placed on the zebrafish visual

system, particularly with respect to estimating environmental and self motion, differ substantially from the demands placed on terrestrial animals. Based on these results, we will explore the implications of the particular patterns of temporal frequency and speed in the zebrafish environment for driving visually-guided behaviors that require motion detection.

Acknowledgements: This project is funded by The Human Frontier Science Program (RGY0079/2018) and NIH (P30EY003176).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 433

Volitional attention guidance fails to extract summary statistics

Poster Presentation - *Topic area: Spatial Vision: Textures, ensembles, figure ground*

Yoshiyuki Ueda[1] (ueda.yoshiyuki.3e@kyoto-u.ac.jp); [1]Kyoto University

Summary statistics (e.g., average) are instantaneously extracted from multiple objects. This is a kind of automatic cognitive processing without much effort. When objects are categorized by a distinct feature (i.e., color), summary statistics of objects with each feature (i.e., red) can be extracted. This indicates a possibility that summary statistics are calculated with attention guidance based on saliency. Attention also has a function of marking objects and excluding them to facilitate processing efficiency even when they have the same physical features (visual marking and preview benefit: Watson & Humphreys, 1997). In this study, I investigated whether volitional attention can organize objects for summary statistics calculation using a preview paradigm. In the whole condition, all dots were simultaneously presented, and the participants clicked the average location of these dots. In the preview condition, a part of dots were initially presented to the participants, and followed by remaining. Participants were asked to indicate the average location of later dots ignoring the initial dots. Experiment 1, in which later dots were simply added to the initial dots, showed that the participants could indicate the average location ignoring the initial dots. That is, error of the average location of dots was not differed between when they were added to the initial display (preview condition) and when they were simultaneously presented (whole condition). Experiment 2, in which a brief blank was inserted before the appearance of the later dots in the preview condition, showed that the preview benefit disappeared. That is, error of the average location of the latter dots in the

preview condition was much larger compared with in the whole condition. These results suggest that summary statistics can work with attention guidance based on saliency, but cannot work with volitional attention guidance.

Acknowledgements: This work was supported by JSPS KAKENHI Grant Numbers 18H03506.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have any questions, please chat to me or contact to my e-mail address directly.

Abstract ID: 1770

Temporal Processing

A network of topographic maps in human association cortex hierarchically transforms visual timing-selective responses

Talk Presentation - *Topic area: Temporal Processing*

Ben Harvey[1], Serge Dumoulin[1,2,3], Alessio Fracasso[2,4], Jacob Paul[1]; [1]Utrecht University, [2]Spinoza Center for Neuroimaging, Amsterdam, [3]VU University, Amsterdam, [4]University of Glasgow

Accurately timing sensory events is crucial when interacting with our dynamic world. This allows complex human behaviors that require timing-dependent multisensory integration and action planning. Such behaviors include perception and performance of speech, music, driving and many sports. How are responses to visual event timing processed for multisensory integration and action planning? We hypothesized that human cortical neural populations may exhibit tuned responses to visual event timing in a network of topographically organized areas. We acquired ultra-high field (7T) fMRI data while showing subjects visual events (a circle appearing and disappearing) that gradually varied the time between circle appearance and disappearance (duration) and/or the time between consecutive circle appearances (period, i.e. 1/frequency). We analyzed these responses with neural population response models selective for event duration and period, following behavioral and computational results, and comparisons to alternative models. We found nine bilateral timing maps, partially left-lateralized and widely spread from occipital visual areas through parietal multisensory areas to frontal action planning areas. Each map showed topographically organized, tuned responses to duration and period, mirroring the organization of sensory cortices and other quantity (e.g. numerosity) processing networks. Duration and period representations

were closely linked. As in sensory cortical maps, response precision varied systematically with timing preferences and timing selectivity systematically varied between maps. Progressing from posterior to anterior maps, responses to multiple events were increasingly integrated, response selectivity narrowed, and responses focused increasingly on the middle of the presented timing range. These timing maps largely overlap with the numerosity map network, suggesting close links to cortical representation of other quantities. Their locations suggest roles in visual motion processing, multisensory integration and sensory-motor transformations. In both visual timing map and visual field map networks, selective responses and topographic map organization may facilitate hierarchical transformations by allowing neural populations to interact over minimal distances.

Acknowledgements: Supported by: Netherlands Organization for Scientific Research (#452.17.012, #016.Vici.185.050); Portuguese Foundation for Science and Technology (#IF/01405/2014); Royal Netherlands Academy of Arts and Sciences (Ammodo award); Biotechnology and Biological Sciences Research Council (#BB/S006605/1).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 538

Contextual and Anchoring Effects on Perceptual Resolutions and Perceived Magnitudes: Within- and Between-Modalities Effects

Talk Presentation - *Topic area: Temporal Processing*

Nahal Binur[1] (nahalbe@gmail.com), Bat-Sheva Hadad[1,2]; [1]Cognitive Developmental Lab, University of Haifa, Haifa, Israel, [2]Edmond J. Safra Brain Research Center, University of Haifa, Haifa, Israel

The perception of magnitude, a crucial ability for a mental representation of the physical world, is often not veridical but subject to significant biases. Many of these biases are similar across different sensory modalities, implying a generalized magnitude perceptual system. At the same time, different physical quantities might also have a specialized representation that is modality specific. To shed light on this question of common versus distinct processes in magnitude representation, the present study examined between- and within-modalities contextual effects on perceptual resolutions of magnitudes. In a constant stimuli procedure, a central standard was embedded within shorter and longer contextual standards. These

contextual standards were sampled from either a relatively wider or narrower range of durations. Participants were required to determine which of the two consecutive durations was longer. In half of the trials the standard was presented first, creating stronger anchoring. A full within-subject design was applied, in which 12 participants completed 8 experimental combinations of visual and auditory modalities, within- and between-modalities context, and narrow and wide ranges. In each, a full individual psychometric function was fitted, with JNDs indicating perceptual resolutions and PSEs indicating perceived durations. Better perceptual resolutions were found for narrower context, with stronger contextual effects for trials in which the standard was presented first (anchoring effects). Consistent with Bayesian account of magnitude perception, contextual effects were stronger in the visual modality where thresholds were elevated. Time-order effects were also found on the perceived duration so that durations were perceptually underestimated for standard-first trials but overestimated for standard-second trials. Interestingly, narrower context enhanced resolutions of standards of within the same modality but failed to show any effect on standards of the other modality. These results suggest a specialized calibration mechanism of contextual effects on perceptual resolutions that is modality-specific.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Hello,
Closed captions are provided as a supplement PDF file, due to technical problems.
Sorry for the inconvenience,
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Nahal
nahalbe@gmail.com

Abstract ID: 1115

Default mode network dynamics track the cognitive state of surprise during naturalistic audiovisual stimulation

Talk Presentation - *Topic area: Temporal Processing*

Talia Brandman[1], Rafael Malach[1], Erez Simony[1,2]; [1]Weizmann Institute of Science, [2]Holon Institute of Technology

The default mode network (DMN) is a group of high-order brain regions, so called for its high baseline signal in the absence of external stimuli. Yet recent advances revealed that it is involved not only in internally-driven processes, but importantly, in the long-timescale processing of external real-life events.

However, the exact role of the DMN in naturalistic processing remains a mystery, due to the difficulty in measuring and relating neural dynamics to the unfolding cognitive experience under naturalistic stimulation. In a new approach, we identify the cognitive states predictive of DMN co-activation (i.e., activity correlations). Particularly, we compared functional magnetic resonance imaging (fMRI) responses to a short movie with the behavioral response pattern elicited by the same movie in a separate group. Behavioral reports for each event in the movie were modeled across time to generate dynamic estimates of the degree of surprise, memorability, emotion, importance and theory of mind. DMN co-activation was measured via inter-subject functional correlation (ISFC). Results revealed that co-activation among DMN regions was reliably predicted by the state of surprise across movie events. Furthermore, co-activation was higher during peak surprise than during other cognitive states (e.g. emotional), in the DMN, but not among dorsal attention or visual areas. Additionally, DMN regions were co-activated with hippocampus and nucleus accumbens as a function of surprise, whereas these subcortical regions showed no direct relation to surprise on their own. These findings reveal a new functional aspect of DMN, linking it to surprise during naturalistic audiovisual processing. This functionality may reflect high-level prediction errors. The engagement of subcortical mechanisms implicated in theories of predictive processing is compatible with this notion. Our findings therefore suggest a role for the DMN in predictive processing during real-life events, likely required for the temporal integration of incoming audiovisual information with long term memory processes.

Acknowledgements: 1. This work was supported by Israel Science Foundation Grant 1458/17; 2. The fMRI portion of the data was obtained with permission from Chen et al. (2016) and Zadbood et al. (2017).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

To read more please see our preprint of this study
https://www.biorxiv.org/content/10.1101/2020.05.18.101758v1

Abstract ID: 348

Supramodal representation of subsecond time and the impact of its training on unimodal temporal interval discrimination

Talk Presentation - *Topic area: Temporal Processing*

SHUCHEN GUAN[1] (scguan@pku.edu.cn), XINGNAN ZHAO[1], YINGZI XIONG[2], CONG YU[1]; [1]Peking University, [2]University of Minnesota

Whether subsecond timing relies on a centralized clock, or on distributed temporal mechanisms, has been a central theme in time research. Current views favor distributed mechanisms because of the interval specificity in temporal interval discrimination (TID) learning, which contradicts a dedicated centralized clock account. We first ran a double training procedure to eliminate interval specificity in learning of TID with intervals marked by pairs of auditory beeps. TID learning was initially interval specific: TID learning with a 100-interval after 5 sessions of practice reduced TID thresholds by 42.8±10.0% at a 100-ms interval ($p<0.001$), but it had no significant impact on TID thresholds at 200-ms (15.9±6.7%, $p=0.15$). However, when TID training at 100-ms was paired with auditory frequency discrimination (FD) learning at 200-ms in alternating blocks of trials, TID thresholds at 100-ms and 200-ms were both improved (41.8±8.9% & 32.7±1.6%, $p<0.001$). A control experiment excluded the possibility that TID improvement at 200-ms was caused by FD learning. Similar double training procedures also enabled complete TID learning transfer between visual and auditory modalities. These results suggest an interval-unspecific supramodal representation of subsecond time. Training may refine this centralized clock-like representation, so that learning can transfer across intervals and modalities. Next we tested whether supramodal TID training could improve unimodal TID performance. Participants practiced supramodal TID of a 200-ms interval defined by an auditory and a visual signal (AV), which not only reduced AV TID thresholds by 36.7±5.4% ($p<0.001$), but also reduced auditory-auditory (AA) TID at 200-ms by 27.8±4.1% ($p<0.001$). Continued training of AA TID failed to further improve AA TID thresholds (0.5±9.2%, $p=0.96$). This finding indicates that precise subsecond timing can be achieved through training of more centralized supramodal timing mechanisms, with no necessity of engaging more peripheral unimodal timing mechanisms.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Please do not hesitate to contact Cong Yu (yucong@pku.edu.cn) or Shuchen Guan (scguan@pku.edu.cn) if you have any questions.

Abstract ID: 1721

Temporal Processing: Duration

Adaptation to visual motion can differentiate between perceptual timing and interval timing

Poster Presentation - *Topic area: Temporal Processing: Duration*

Aurelio Bruno[1] (aurelio.bruno@york.ac.uk), Federico G. Segala[1], Iona Smith[1], Daniel H. Baker[1]; [1]University of York

The mechanisms that underlie time perception have been the object of an ongoing debate. Some theories propose a single centralized mechanism responsible for the encoding of duration, whereas others propose that time perception is the product of a network of distributed mechanisms. The proponents of the latter view hypothesize that different mechanisms operate at different time scales. In this study, we aimed to investigate whether a well-known duration aftereffect induced by adaptation to visual motion in the sub-second range, which is often referred to as 'perceptual timing', also occurs in the supra-second range (called 'interval timing'), which is more accessible to cognitive control. In the adaptation phase, participants were required to fixate the centre of the screen, while an adaptor (a drifting Gabor) was displayed on one side of the monitor (initially for 32 seconds, with 8-second top-ups). The speed of the adaptor alternated between 5 and 20 °/s over time in order to minimize changes in perceived target speed. In the test phase, participants were required to judge the relative duration of two intervals containing Gabors drifting at 10 °/s, which were sequentially displayed on either side of a central fixation spot, one in the same location as the adaptor and the other in an unadapted location. We observed that adaptation substantially compressed the apparent duration of a 600 ms interval, whereas it had little effect on a 1200 ms interval. Duration discrimination thresholds after adaptation did not differ between the two durations and they were comparable to those observed without adaptation, implying that the observed differences in perceived duration cannot be ascribed to changes in attention or to noisier estimates. This pattern of results indicates that we can use adaptation to visual motion as a tool to investigate the mechanisms underlying time perception at different time scales.

Acknowledgements: The Wellcome Trust

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

I am a Wellcome Trust research fellow at the University of York, UK. My research interests are focused on time perception, visual stability during eye-movements and gaze perception in neurotypical and clinical populations.

You can check my work or contact me in the following ways:

email: aurelio.bruno@york.ac.uk

university webpage: https://www.york.ac.uk/psychology/staff/postdocs/ab2719/
researchgate: https://www.researchgate.net/profile/Aurelio_Bruno
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Abstract ID: 1049

Effect of subjective visibility on response priming

Poster Presentation - *Topic area: Temporal Processing: Duration*

Yukihiro MORIMOTO[1] (sza02290@edu.osakafu-u.ac.jp), Shogo MAKIOKA[2]; [1]Osaka Prefecture University

Response priming is a phenomenon that responses are faster when target and prime elicit the same response (congruent condition), compared with when they elicit the opposite responses (incongruent condition). The effect occurs even when the prime is invisible. However, the effect of visibility on the priming has not been verified. In addition, it is not clear whether the effect depends on the promotion of response by the congruent prime or the inhibition by the incongruent prime. In Experiment 1, we examined the effect of the SOA between the prime and the target and the visibility of the prime. In Experiment 2, the effect of visibility under constant SOA was examined. We used Perceptual Awareness Scale (PAS) as an index of the subjective visibility of the prime. Thirty-one undergraduate students participated in Experiment 1, and twenty-three undergraduate student participated in Experiment 2. Participants were told that two arrows were presented in succession and the first arrow (prime) might be invisible but the second arrow (target) was always visible. They were instructed to tilt the joystick in the direction of the target arrow as quickly and accurately as possible, and then to report the visibility of the prime. The visibility was classified either of 0 (nothing was seen at all), 1(something was seen), 2(an arrow was visible), or 3(an arrow was clearly visible). Analyses by linear mixed model confirmed that the prime visibility affects the strength of the response priming independently of the SOA in both Experiments 1 and 2. The inhibitory effect by the incongruent prime was observed in both Experiment 1 and 2. This suggests that the response priming was mainly produced by inhibition from the incongruent prime.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
24 June, 2:00 am EDT America/New_York

Presenter's Message

Personal Home Page: https://yukihiro00.github.io/Morimoto-Yukihiro/English/
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Twitter ID: https://twitter.com/YCogpsy

Hello, everyone, I'm Yukihiro MORIMOTO.
Comments and opinions on poster presentations can be sent via Twitter DM or email.
Considering the communication environment, I am not active in video conferencing, but I would like to utilize the zoom's real-time chatting.
I look forward to discussions with you.

Abstract ID: 202

Has half the time passed? Investigating time perception at long time scales

Poster Presentation - *Topic area: Temporal Processing: Duration*

Sandra Malpica[1] (sandramalpicam@gmail.com), Belen Masia[1], Laura Herman[2], Gordon Wetzstein[3], David Eagleman[4], Diego Gutierrez[1], Zoya Bylinskii[2], Qi Sun[2]; [1]Universidad de Zaragoza, I3A, [2]Adobe Research, [3]Stanford University, [4]Department of Psychiatry, Stanford University School of Medicine

Time perception is fluid, and can change in response to different visual inputs. Previous literature shows that time perception at short (millisecond timing) intervals is affected by low-level aspects of visual stimuli, including luminance contrast and temporal frequency. At long intervals, high-level aspects like emotions elicited by visual input affect time perception, but are confounded with semantics. For the first time, we investigate the effects of changes in low-level aspects of visual input on time perception at long intervals (30 seconds to 3 minutes). We conduct experiments in traditional displays (TD) and virtual reality (VR), and find that luminance contrast, temporal frequency of presentation, and field of view (FoV; tested in VR only) have significant effects on time perception. Using a 2AFC task, participants judge whether less or more than half of a trial's duration has elapsed at a given sampling point (45% or 55% of the total trial duration). Prior to each experiment, participants are presented with a sample trial and told when 50% of the time has elapsed. Participants perform 8-12 trials at a fixed viewing duration. First, we find that contrast and frequency have significant effects on time judgements of 30s trials with static images in TD. Second, we replicate these results in VR, and also find a significant effect of FoV. Third, the effects of contrast and frequency hold up when using 30s trials of video clips in TD. Fourth, we extend our experiments to longer blocks of up to 3 minutes while varying stimuli frequency, and find consistent results. Our results show that higher frequency, higher contrast, and larger FoV (bigger visual magnitude changes) shorten perceived time. These results provide a means of modifying visual stimuli to change their perceived duration.

Acknowledgements: This work was part of an internship at Adobe research. This work was funded by a Consolidator Grant from the European Research Council (CHAMELEON proj., grant agreement #682080), Spanish Ministry of Economy and Competitiveness (TIN2016-78753-P). SM was supported by a DGA predoctoral grant.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

Don't hesitate to talk with me for any discusion related to our poster, I will be more than happy to answer your questions =)

Abstract ID: 489

Neural entrainment influences visual perception without the conscious perception of stimulus changes

Poster Presentation - *Topic area: Temporal Processing: Duration*

Luhe Li[1] (luhe.li.ut@gmail.com), Yuko Yotsumoto[1]; [1]The University of Tokyo

Rhythmic visual stimulation can cause neural entrainment, the synchronization of intrinsic oscillations and the external stimulus rhythms. Neural entrainment has been reported to modulate perceptual processes, such as enhancing perceived brightness and facilitating temporal prediction. However, flicker-induced neural entrainment effect is confounded by change saliency, the subjective perception of stimulus changes. It remains unclear whether neural entrainment without change saliency could influence visual perception. To preclude change saliency, we used frequencies higher than the critical fusion threshold to render flicker perception stable. Importantly, we simultaneously presented two flickers at 55.5 Hz and 62.5 Hz while measuring electroencephalography to assess whether their beat frequency (i.e., 7 Hz) arose by the nonlinear processing at the visual cortex. To test the influence of neural entrainment at the beat, we used this combined flicker in a duration discrimination task with a two-alternative forced-choice design. In this task, 17 participants compared seven durations of the combined flicker with the standard duration of a stable stimulus. Behavioral results revealed that the combined flicker induced time dilation, supporting the engagement of neural entrainment. We also conducted the power analysis, inter-trial coherence analysis, and rhythmic entrainment source separation that could increase the signal-to-noise (SNR) ratio of SSVEPs. The SNR at the lower fundamental frequency was significantly larger than the control condition, suggesting that the neural entrainment of fundamental frequencies was successful. We concluded that neural entrainment could influence visual perception without the conscious perception of stimulus changes, while stronger neural entrainment methods are needed to further examine the existence of the beat derived from high frequencies.

Acknowledgements: This work was supported by Grants-in-Aid for Scientific Research (KAKENHI #19H01771, #19H05308, #17K18693)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 1:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 487

Spatial crowding distorts the perceived duration of visual stimuli

Poster Presentation - *Topic area: Temporal Processing: Duration*

Sofia Lavrenteva[1], Ikuya Murakami[1]; [1]The University of Tokyo, Department of Psychology

To assess what kinds of visual information affect perceived time and in what ways, we investigated whether the ease with which a stimulus can be discerned affects its perceived duration. We compared perceived duration between readable and crowded stimuli. Each stimulus was presented on a gray background in the periphery of the right visual hemifield and consisted of a target (one of eight digital letters) surrounded by ten flankers (digital number ‘8’) arranged horizontally, five to the left and five to the right of the target. The target and flankers were either black or white. In a readable stimulus condition, only the outermost flankers had the same color as the target (e.g., white) whereas all other flankers had the opposite color (e.g., black), so that the target letter was easier to read. In a crowded stimulus condition, the target and its nearest neighbors had the same color whereas all other flankers had the opposite color, thus the target was crowded and harder to read. We found that the readable stimuli appeared to last longer than the crowded ones. This illusory duration distortion was more pronounced when the participants additionally performed a letter identification task. The distortion was stronger when the flankers appeared before the target and disappeared after its offset, so that the duration of the flankers could not be used as a cue to judge the target duration. The distortion disappeared when the participants additionally performed a position discrimination task for a clearly visible red dot superimposed on the target letter. Therefore, we concluded that it was the target letter in particular that exhibited illusory duration distortion, such that the duration appeared longer when the letter was easier to read than when it was harder. We discuss the implications of this effect for duration perception and its possible mechanisms.

Acknowledgements: Supported by KAKENHI 18H05523

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 627

Tachypsychia —the subjective expansion of time— happens in immediate memory, not perceptual experience

Poster Presentation - *Topic area: Temporal Processing: Duration*

Ian Phillips[1] (ianbphillips@gmail.com), Aditya Upadhyayula[1], Jonathan Flombaum[1]; [1]Johns Hopkins University

Tachypsychia is the distortion of the experienced passage of time. In the lab, the phenomenon has been studied psychophysically under the label ‘subjective time expansion.’ Notably, Tse and colleagues (2004) demonstrated how unexpected visual events, ‘oddballs,’ are perceived as lasting longer than expected ‘standard’ events. For example, a looming disk seems to last longer when it follows otherwise identical (and equal duration) static disks. Is this evidence of experienced or remembered time as passing more slowly? If we could isolate individual moments during an extended duration, would each moment be longer such that they add up to a longer total? We report results that suggest instead that a whole ‘oddball’ experience is only remembered as lasting longer. We replicated several of Tse et al.’s experiments, focusing on duration reproduction methods. Participants held down a key to reproduce the duration of the last disk in a series. In the replication, the final disk was either an oddball or a standard. Oddballs were reproduced as lasting longer. In a modified experiment, the final disk was always a standard. However, critically, the keypress used to reproduce duration initiated the onset of another disk which was either an oddball or another standard. Releasing the key removed the oddball or standard. Subjects were instructed to produce a disk that reproduced the duration of the last disk seen. If oddballs expand experienced time, then this manipulation should replicate the typical oddball effect. Instead, we found no difference for oddballs compared to standards. The same was true in an auditory version of the experiment where reproduction keypresses onset and offset an oddball or standard tone. Together with additional controls and replications, these results suggest that the experienced passage of time is not distorted by oddball stimuli. Rather the passage of time can become immediately distorted in memory.

Acknowledgements: NSF PAC Award #1534568

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1466

The Limited Capacity of Visual Temporal Integration in Cats

Poster Presentation - *Topic area: Temporal Processing: Duration*

Xiaohan Bao[1], Anas Salloum[4], Stephen Gordon[5], Stephen G. Lomber[2,3]; [1]Integrated Program in Neuroscience, [2]Department of Physiology, [3]Department of Neurology and Neurosurgery, Faculty of Medicine, McGill University, Montreal, Canada, [4]Undergraduate Program in Physiology and Pharmacology, [5]Graduate Program in Neuroscience, University of Western Ontario, London, Canada

It has been long known that prolonging stimulus duration may increase the perceived brightness of a stimulus by our visual system. The trade-off interaction between intensity and duration generally follows a rule, such as described in Bloch's law. Similarly, auditory temporal integration has been investigated using the cat as an animal model. The goal of this study is to develop a visual task whereby the cat can be used as a suitable model for studying both auditory and visual temporal integration. We successfully trained five cats to remain stationary during fixation and make a response by rapidly approaching a reward dispenser when a brief luminance change was detected in the fixation dot. Following training, we measured the success rate of detecting the luminance change with varying durations (17-ms, 50-ms, 83-ms, 117-ms, 150-ms, 183-ms) at threshold, subthreshold, and suprathreshold luminance levels. Psychometric functions averaged across 13 testing sessions showed that the effect of prolonging stimulus duration on improving the task performance was statistically significant ($F_{5,72}=2.61$, $p=0.032<.05$) and was most noticeable for stimuli shorter than 83-ms. Psychometric functions derived from 9 out of 13 individual sessions were better fit to an exponential model than to a linear model. The gradually saturated performance observed here, as in previous studies, can be explained by the "leaky integrator" hypothesis, where temporal integration is considered valid only when sensory input falls within a time window whose length defines a critical duration. The performance saturation is unlikely to be a ceiling effect caused by task proficiency, as the success rate for the longest stimuli were still modulated by luminance level. Based on the outcome of this study, future research can consider using the cat as an animal model to investigate the factors on temporal integration, such as modal-specificity, inhibition, subject bias, and their underlying neural circuits.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 760

Temporal Processing: Mechanisms

Adaptive read-out: the role of sensory adaptation in serial dependence

Poster Presentation - *Topic area: Temporal Processing: Mechanisms*

Timothy Sheehan[1], Chaipat Chunharas[2], John Serences[1]; [1]UC San Diego, [2]Chulalongkorn University and King Chulalongkorn Memorial Hospital

Humans perceive objects as more similar to recently attended objects than they actually are. This phenomenon, coined serial dependence, is thought to be driven by priors based on the assumption of object permanence. We used fMRI and a linear decoder to investigate how population representations of orientation differed as a function of trial history during a change detection task (Fig1a,b). Behavioral measures indicate that participants showed strong attractive serial dependence (Fig1c, black). Single-trial decoding of fMRI response patterns in visual cortex also revealed strong serial biases (Fig1c, dark-blue) but in the direction opposite to the behavioral bias. The decoded biases were consistent with sensory adaptation whereby populations that were highly active on one trial were less active on the next trial. We hypothesized that readout from early sensory areas accounts for adaptation in normal sensory contexts and that this 'accounting' over-compensates in instances of serial dependence (attraction) and under-compensates in instances of behavioral adaptation (repulsion). To simulate this mismatch between expected and true adaptation, we treated observed neural adaptation from passive viewing (approximating 'natural' viewing) as the expected adaptation (Fig1c, light-blue) and subtracted this bias from the true neural adaptation observed in our memory task (Fig1c, dark-blue). This residual neural bias was transformed into predicted bias and was found to closely track both the shape and magnitude of the observed behavioral biases (Fig1d, red). The 'over-adaptation' model predicts that adaptation on an individual trial should be negatively correlated with serial dependence, a pattern that we directly observed at the level of single trial responses in our data. This model, whereby expected adaptation is accounted for, can be seen as an implicit encoding of the prior belief of object semi-permanence leading to attraction when objects change 'too-quickly' (aiding coherent representations) and repulsion when objects change 'too slowly' (aiding change detection).

Acknowledgements: NEI-EY025872

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

For issues with video chat or if you would rather chat over google video, contact @ timothysheehanc@gmail.com

Abstract ID: 1628

Modeling the temporal dynamics of neural responses in human visual cortex

Poster Presentation - *Topic area: Temporal Processing: Mechanisms*

Iris Groen[1] (ig24@nyu.edu), Giovanni Piantoni[2], Adeen Flinker[3], Sasha Devore[3], Orrin Devinsky[3], Werner Doyle[3], Nick Ramsey[2], Natalia Petridou[2], Jonathan Winawer[1]; [1]New York University, New York, USA, [2]University Medical Center Utrecht, Utrecht, Netherlands, [3]New York University School of Medicine, New York, USA

Cortical responses to visual stimuli exhibit complex temporal dynamics, including sub-additive temporal summation, response reduction with repeated or sustained stimuli (adaptation), and slower dynamics at low contrast. Multiple computational models have been proposed to account for these dynamics in several measurement domains, including single-cell recordings, psychophysics, and fMRI. It is challenging to compare these models because there are differences in model form, test stimuli, and instrument. Here we present a new dataset that is well-suited to compare models of neural temporal dynamics. The dataset is from electrocorticographic (ECoG) recordings of human visual cortex, which measures cortical neural population responses with high spatial and temporal precision. The stimuli were large, static contrast patterns and varied systematically in contrast, duration, and inter-stimulus interval (ISI). Time-varying broadband responses were computed using the power envelope of the band-pass filtered voltage time course (50-170 Hz) recorded from a total of 126 electrodes in ten epilepsy patients, covering earlier (V1-V4) and higher-order (LO, TO, IPS) retinotopic maps. In all visual regions, the ECoG broadband responses show several non-linear features: peak response amplitude saturates with high contrast and long stimulus durations; response latency decreases with increasing contrast; and the response to a second stimulus is suppressed for short ISIs and recovers for longer ISIs. These features were well predicted by a computational model (Zhou, Benson, Kay and Winawer, 2019) comprised of a small set of canonical neuronal operations: linear filtering, rectification, exponentiation, and a delayed divisive gain control.

These results demonstrate that a simple computational model comprised of canonical neuronal computations captures a wide range of temporal and contrast-dependent neuronal dynamics at millisecond resolution. Finally, we present a software repository that implements models of temporal dynamics in a modular fashion, enabling the comparison of many models fit to the same data and analyzed with the same methods.

Acknowledgements: This work is funded by BRAIN Initiative Grant R01-MH111417

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 582

Visual discriminability oscillates after a single flash

Poster Presentation - *Topic area: Temporal Processing: Mechanisms*

Yong-Jun Lin[1] (yjlin@nyu.edu), Zanetta Kovbasyuk[1], Zhilin Zhang[1], Elma Chowdhury[2], Marisa Carrasco[1];
[1]New York University, [2]Johns Hopkins University

[Goal] Recent studies have reported that alpha band (8-12 Hz) entrainment by periodic visual flashes can cause performance oscillations in hit rate or reaction time over several cycles. Here, we investigated whether a single flash is sufficient to trigger oscillations in discriminability over time. [Methods] Observers performed a 2AFC orientation discrimination task on Gabor patches. We titrated individual orientation discrimination thresholds at 79% accuracy for each visual hemifield. Gabor patches were presented in both hemifields for 50 ms following 15 unilateral flashes within the alpha band frequency range (Experiment 1) or a single unilateral flash (Experiment 2), with delays ranging from 100 to 250 ms in 16.7 ms steps. Shortly after stimulus offset, a response cue indicated the target Gabor. [Results] In Experiment 1, most observers showed significant unilateral or bilateral visual discriminability (d') oscillations, after entraining either the left or the right hemifield. Remarkably, in Experiment 2, most observers also showed significant unilateral or bilateral d' oscillations when either hemifield was stimulated with just a single flash. In both experiments, the oscillation amplitudes were similar and the d' oscillations ranged from 8 to 29 Hz in frequency. [Conclusions] These novel results show that visual discriminability oscillates following either a single visual flash or alpha band periodic flashes. The onset of a flash is likely to phase-reset neural oscillations and elicit d' oscillations. These results indicate that entrainment with periodic flashes is not

necessary for performance oscillations, and suggest that internally-driven rhythms, encompassing alpha band and beyond, modulate visual discrimination sensitivity.

Acknowledgements: Funding source: NIH R21-EY026185-01A1

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Now there is an extra presenter's conference session:
Tuesday, 6/23/20, 15:00 EDT America/New_York

Abstract ID: 1284

Temporal Processing: Models

A Generative Model for Tumor Stimuli Synthesis

Poster Presentation - *Topic area: Temporal Processing: Models*

Zhihang Ren[1] (peter.zhren@berkeley.edu), Tsung-Wei Ke[1], Stella X. Yu[1], David Whitney[1]; [1]University of California, Berkeley

Recent studies have shown that previous visual stimuli can affect current visual perception. It is believed that such serial dependency can help to increase perceptual stability since our visual world tends to be stable over space and time. However, when radiologists review mammographies in a sequence, their visual world does not necessarily have the assumed stability due to variations in the patients, scanners, and tumor types. Serial dependency may thus strongly influence radiologists' decisions and diagnoses. Understanding the mechanism could potentially lead to new strategies that prevent radiologists from making biased decisions. In order to study the role of serial dependency in radiography recognition, we need to be able to generate visually related stimuli in a sequence. Synthetic tumor stimuli are typically generated by applying simple spatial deformation and intensity filtering operations such as blurring in masked areas. However, synthetic scans from such image manipulations often appear implausible to a radiologist, because they are not metamers for real tumors and are often anatomically inconsistent with the surrounding tissues. Our goal is to synthesize realistic new tumor images from a small set of real scans. We leverage recent advances in deep learning to generate synthetic mammographies that conform to the statistical pattern distributions exhibited in the real scans. We build such a generative model based on

Digital Database for Screening Mammography (DDSM) dataset, which has 2,620 cases of normal and tumor scans. Our model can synthesize new scans that have tumors similar to source images, seamlessly embedded into the target background image. We are exploring additional Generative Adversarial Network (GAN) models that produce high-resolution synthetic scans with realistic variations in both foreground tumor regions and surrounding tissues.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
22 June, 11:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1712

Duration threshold: A new approach to estimate decision-making time.

Poster Presentation - *Topic area: Temporal Processing: Models*

Ying Lin[1,2], Duje Tadin[1,2]; [1]University of Rochester, [2]Center for Visual Science

Reaction times (RTs) are used extensively to study decision-making, including to estimate the speed of decision-making processes. RT, however, is composed of various components (i.e. motor response speed). As only a portion of measured RTs represents decision time, RTs need to be decomposed into their components to estimate decision time; a task that is usually done using drift-diffusion models (DDM; Ratcliff & McKoon, 2008). Here we consider a different approach that relies on duration threshold measurements, defined as the shortest presentation time sufficient to accurately perceive a time-limited stimulus. For example, when a stimulus is noisy, a longer presentation duration will be needed to accumulate enough information for an accurate response. Here, we aimed to test whether duration thresholds can provide information that corresponds to decision times extracted from RTs using DDM. We measured motion direction discriminations for moving Gabor patches at two contrasts (low: 2.1%; high: 92%) and three sizes (1.2, 2.7- and 6-degrees radius). At low contrast, participants (n = 8) performed better (i.e. lower duration threshold) as size increases, while at high contrast, participants performed worse as size increases. These results replicated previous findings of contrast-dependent spatial suppression (Tadin et al., 2003). The overall RTs with the same stimuli did not reveal the same pattern of results. However, decision times extracted from RTs using a DDM did closely follow duration threshold results. Across

individuals, we found that decision times are highly correlated with duration thresholds (r > 0.90). These results suggest that duration thresholds can be used as a measure of decision time, with an added benefit of not including non-decision processes (e.g., motor speed) or requiring the use of DDMs to extract the decision time component. We are currently extending these results in the context of a static orientation discrimination task while varying stimulus contrast.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for your interest in my poster presentation. Please do not hesitate to email me about any questions or concerns (ylin78@ur.rochester.edu). I will promptly respond to your messages. Thank you again!

Abstract ID: 1123

Reverse correlation analysis of a reaction time task for stochastic stimuli

Poster Presentation - *Topic area: Temporal Processing: Models*

Hironori Maruyama[1], Hiromi Sato[1], Ryuto Yashiro[1], Isamu Motoyoshi[1]; [1]Department of Life Sciences, The University of Tokyo

To understand how humans utilize visual information up to the moment of making a decision, the present study applied a reverse-correlation analysis to behavioral responses in a reaction-time (RT) task for stochastic orientation stimuli. Each stimulus consisted of a dynamic texture (15 Hz frame rate) composed of Gabor elements whose orientation varied randomly according to Gaussian noise sampled in both the space and time domains. During stimulus presentation, observers pressed a button as soon as possible and indicated whether average spatiotemporal orientation appeared tilted clockwise or anti-clockwise. RTs ranged from ~500 to 2000 ms, and we calculated logistic-regression coefficients between observer RTs and spatial mean-orientation for each temporal frame. The analysis revealed a sharp peak in regression coefficients at 400-500 ms prior to the motor response. The peak was less pronounced for trials with longer RTs. Subsequent analysis showed that, within a temporal period around this peak, spatial mean-orientation was larger (i.e., more tilted) and the spatial variance of orientation was narrower than the other periods. Results indicate that, at least under time-constrained situations, human perceptual decision making is dominated by stimulus information presented 400-500 ms before the motor response. Qualitatively, this behavior can be accounted for by a standard drift-diffusion mechanism that receives delayed sluggish inputs of ensemble orientation signals from the early visual system.

Acknowledgements: Supported by the Commissioned Research of NICT (19401), and by JSPS KAKENHI JP15H05916, JP15H03461 and JP16J07259.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 934

Temporal hierarchies in visual statistical learning: Behavioral, neuroimaging, and neural network modeling investigations

Poster Presentation - *Topic area: Temporal Processing: Models*

Cybelle Smith[1] (cybelle@sas.upenn.edu), Anna Schapiro[1], Sharon Thompson-Schill[1]; [1]University of Pennsylvania

How does the brain encode visual context at different temporal scales? When processing familiar sensory and semantic input, cortex is sensitive to input further into the past along a posterior to anterior gradient (Hasson et al. 2015). To investigate how we learn new hierarchical temporal structure in the visual domain, we designed a novel paradigm employing statistical learning that can be used to map neural contributions to contextual representation at different time scales. Over four behavioral experiments (N=72), we demonstrate that humans are sensitive to transition points among both low- and high-level sequential units during exposure to sequences of abstract images (fractals). However, results may be attributable to low-level learning of image trigrams. Thus, we altered the paradigm to more effectively disentangle learning of nested order information at slow and fast temporal scales. One of eight context cue images is presented multiple times, and embedded in this stream are paired associate images. Critically, pairwise contingencies depend on both the identity of the context cue (fast temporal scale) as well as the time since the previous context shift (slow temporal scale). We have found that multi-layer recurrent neural networks trained to predict the upcoming image in this paradigm encode order information at shorter time scales at lower levels (closer to perceptual input). However, only neural architectures that can remember further into the past (i.e. those using long-short term memory units, rather than simple recurrent units) can learn the slow temporal structure. Planned neuroimaging work will test the idea that brain regions similarly spatially segregate these timescales. In particular, we anticipate that the hippocampus will represent these hierarchical timescales on an anterior-posterior gradient and that prefrontal cortical regions will be engaged along a lateral-medial gradient.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for stopping by my poster! I'm happy to chat and to answer any questions you might have :)

In addition to the 5-minute teaser video in the poster booth:
https://www.youtube.com/watch?v=-9d4uSxok5o

You can also view a longer walk-through of the poster here:
https://www.youtube.com/watch?v=DNS4dVtnsgM

Abstract ID: 1393

The role of temporal relations in the visual perception of the spatial extent of symmetrical objects that change in size with high speed

Poster Presentation - *Topic area: Temporal Processing: Models*

Sergei Artemenkov[1] (slart@inbox.ru); [1]Moscow State University of Psychology and Education (MSUPE)

The conducted experimental study is devoted to the verification of theoretical assumption about the role of time in human visual perception of the spatial extent. This assumption is associated with the sequential formation of relations between individual discrete time instants of visual process and, in particular, can explain the special phenomena of perception of short-term display of objects that vary in size at a fairly high speed. It is usually impossible for these stimuli with a speed of resizing up to 15 visual deg/s to clearly see the start of the process, while the final position of the object can be observed regardless of the direction of resizing. Moreover, the theoretical model of the formation of temporal relations also indicated the possibility of the appearance of a reversed vision effect of the initial and final positions of stimuli, decreasing in size at speeds of 15-40 deg/s. Their initial position can be observed, and the final position can be seen worse, possibly due to the later establishment of spatial symmetrical relations for the initial case. This effect was shown in our experiments earlier for contour shapes (high-contrast outline drawings of polygons) that vary in size 7-12 degrees and was recorded in submitted experiments using modern computer equipment (including G-Sync monitor with 240 Hz refresh rate, mean frame time 4.2 ms, s.d. 0.02) and special experiment software based on PsychoPy. A higher rate of resizing (up to 55 deg/s and more) leads to a peculiar freezing of all presented frames of the contour object in the form of barely appearing lines, while the global sense of expansion or contraction of size in time stands out separately. This is possibly due to the fact that consistent relationships in time do not have time to form outside the dynamic functional range of human vision.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Reading the text of the presentation - from the upper left corner from top to bottom and from left to right.
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Abstract ID: 447

Using a perceptual confirmation bias to study learning and feedback in fovea and periphery

Poster Presentation - *Topic area: Temporal Processing: Models*

Ralf M Haefner[1] (ralf.haefner@gmail.com), Ankani Chattoraj[1], Richard D Lange[1]; [1]University of Rochester

When temporally integrating information, humans are often, but not always, biased to overweight early evidence (Nienborg et al 2009, Kiani et al 2008). In a previous study (Lange et al 2018) we could explain these apparently conflicting results by assuming that the brain performs approximate inference in a hierarchical model in which expectations influence sensory inferences. Here, we use this framework to ask two related questions for which our model makes testable predictions: (1) Does perceptual decision-making adapt to the rate at which new visual information is presented, or are its assumptions about the temporal input correlations fixed, learnt over long times? (2) Does the strength of feedback differ between fovea and periphery, as recently proposed (Zhaoping et al 2017 and 2018)? In our experiments, we show ten visual frames of band-pass-filtered noise with orientation power centered on -45 or +45 degrees, respectively. For Experiment 1, the stimulus was presented as an annulus spanning 2.1 degrees around the fixation point and we compared two variations of this experiment: one where each evidence frame had a duration of 42ms, and the other where the duration was 166ms. For Experiment 2 we kept duration of each evidence frame fixed (83ms) and varied the eccentricity of the stimulus, comparing 2.1 degrees and 9.0 degrees. We found that the strength of the temporal integration bias differed when measured in physical time, but stayed the same in “frame-time”, indicating that the brain had adapted to the rate at which it received independent visual information. Second, we compared the strength of the primacy effect near the fovea and in the periphery, and did not find a significant difference, suggesting similar strength of feedback near the fovea and at moderately peripheral locations.

Acknowledgements: R01 EY028811-01, T32 EY007125, NSF-1449828

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1695

Temporal Processing: Timing perception

Effects of attentional load on the reproduction of visually marked rhythmic intervals compared to auditory modality in older adults.

Poster Presentation - *Topic area: Temporal Processing: Timing perception*

Elisa M. Gallego Hiroyasu[1], Yuko Yotsumoto[1]; [1]The University of Tokyo

There is auditory dominance compared to visual in temporal perception. However, it is unclear whether it is due to visual processing eliciting a higher demand of attentional resources. If higher attentional resources are required in the visual domain, it is expected that the performance would decline with age in relation to decreasing cognitive capacity. That is, with age, we expect to see a larger contrast between modalities such that the performance of visual modality has a larger decline, given that the auditory stimulus is within their hearing range. In experiment 1, we asked 15 old (Mean age =71.1; SD =4.02) and 15 young adults (Mean age =21.9; SD =2.67) to do a rhythmic reproduction task and reproduce temporal intervals of over and under one second marked by visual and auditory stimuli. We corroborated previous studies demonstrating that the visual domain was less accurate, and found that both modalities were equally precise in both age groups, despite older adults having more variability than their younger counterparts, irrespective of modality. In experiment 2, we added a working memory task to the temporal task to see how a higher demand in attentional load would affect the reproduction of visual stimuli in 15 old adults (Mean age =73.6; SD =3.33) compared to 15 young (Mean age =22.2; SD =2.14) adults. We hypothesized that the under-reproduction of visual stimuli would be intensified with age compared to the auditory modality. However, results showed that there were age-related differences in the modality in such a manner that unlike the younger, older adults performed better in the visual modality compared to the auditory modality. Moreover, the increased attentional load did not increase the level of noise in either modality. We will further discuss why this may be the case.

Acknowledgements: KAKENHI #19H01771, #19H05308, #17K18693

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 1:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 604

Time for a change: time-dependent impact of progress indicators on performance in a challenging task-interleaving scenario

Poster Presentation - *Topic area: Temporal Processing: Timing perception*

Olga Lukashova-Sanz[1] (olga.lukashova@uni-tuebingen.de), Siegfried Wahl[1,2], Katharina Rifai[1,2]; [1]University of Tuebingen, [2]Carl Zeiss Vision International GmbH

Task interleaving becomes particularly challenging when it requires accurate time estimation, which can result in a sub-optimal task-interleaving strategy. In the current study, we focus on the role of time-indicating visual information in its impact on task performance. To do so, visual stimuli indicating process progress were applied in a dual task-interleaving scenario with the unequal importance of each task. Implicit visual task progress indicators were provided with varying time-lead before an optimal task-switch moment in time. During the experiment, each participant interleaved two tasks with the ultimate goal to maximize the total score over each sixty-seconds trial. The relative importance of tasks was set through an asymmetric penalty function expressed by a score. The task-interleaving scenario was implemented in an interactive dynamic virtual environment. The mean visit time in the lower-penalty task, as well as the total performance over each trial, were compared among implicit progress indicators of varying time-leads. A significant effect of stimulus time-lead was found on the mean duration of the visit of the lower-penalty task, as well as on the total score. Therefore, subjects optimize a task-interleaving strategy by exploiting additional temporal information in an asymmetric-penalty task-interleaving scenario. Furthermore, exploitation efficiency is time-lead dependent. Thus, the current study serves as a tool for evaluation of the time-dependent properties of information processing for task-optimization in behavioral scenarios.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 662

Vision in Immersive Environments

A scene with an invisible wall - the role of navigational experience in visual scene perception

Talk Presentation - *Topic area: Vision in Immersive Environments*

Soojin Park[1] (soojin.park@yonsei.ac.kr), Donald Shi Pui Li[2], Jiayu Shao[2], Zhengang Lu[3], Michael McCloskey[2]; [1]Yonsei University, [2]Johns Hopkins University, [3]University of Pennsylvania

Visual perception plays a central role in guiding navigation through the environment. Many previous studies have investigated how visual features of scenes (e.g., landmarks) influence navigation. In this study we take a different approach, asking how navigational experience with a scene affects behavioral and neural responses to the scene. We used virtual reality (VR) software to manipulate navigational experience while holding constant the visual properties of scenes. Participants navigated through VR outdoor environments, and performed a simple object detection task at a particular scene location. In half of the environments (navigable environments), participants could continue walking through the scene after performing the task. However, in the other half of the environments (non-navigable), participants could not continue forward, as if an invisible wall blocked navigation even though the scene was visually navigable. Assignment of visual environments to navigable and non-navigable conditions was counterbalanced across participants, so that the environments were the same in both conditions. In Experiment 1, participants experienced navigable and non-navigable environments and then performed a task in which they judged whether two scenes were visually the same or different. “Different” decisions were significantly slower when the scenes matched on navigability, than when the scenes differed in navigability. The effect remained significant even after regressing out visual similarities between scene pairs. Experiment 2 examined the effects of navigation experience on neural representations of scenes. Using slow-event related fMRI, we found that the multi-voxel pattern of the parahippocampal place area (PPA) distinguished visually identical scenes based on prior navigational experience. These results suggest that the PPA represents information about navigability obtained through prior experience, beyond those computable from the visual properties of the scene. This modulation of visual perception by prior navigational experience may help us construct a functionally meaningful visual environment.

Acknowledgements: This work was supported by National Eye Institute (NEI) grant (R01EY026042) to MM and SP, National Research Foundation of Korea (NRF) grant (funded by MSIP-2019028919) and Yonsei University Future-leading Research Initiative (2018-22-0184) to SP.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 990

Active Vision Impacts How We Move Our Eyes and What We Attend To: Evidence from Eye-tracking in Immersive, 360° Real-World Environments

Talk Presentation - *Topic area: Vision in Immersive Environments*

Amanda J Haskins[1] (ajh.gr@dartmouth.edu), Jeffrey Mentch[2], Thomas Botch[1], Adam Steel[1], Caroline Robertson[1]; [1]Dartmouth College, [2]Harvard University

Eye-tracking studies offer substantial insight into cognition, revealing which visual features viewers prioritize over others as they construct a sense of place in an environment. Yet, one key feature of real-world experience is overlooked by traditional eye-tracking paradigms. Everyday visual environments are actively explored: we gain rich information about a place by shifting our eyes, turning our heads, and moving our bodies. In this study, we sought to understand how active exploration impacts the way that humans encode the rich information available in a real-world scene. To test this, we exploited recent developments in immersive Virtual Reality (iVR) and custom in-headset eye-tracking to monitor participants' (N=18) gaze while they naturally explored real-world, 360º photospheres via head turns and eye movements (Active Condition). In half of the trials, photospheres were passively displayed to participants while they were head-fixed (Passive Condition), thus enabling us to perform quantitative, in-depth comparisons of gaze behavior and attentional deployment as subjects encoded novel real-world environments during active exploration vs. passive viewing. We report that active viewing impacts all aspects of gaze behavior, including 1) low-level oculomotor movements and 2) how individuals allocate their attention. Relative to fixations made in the passive fixation, active fixations were shorter ($p < 0.001$), more frequent ($p < 0.001$), less centrally tending ($p < 0.001$), and more entropic ($p < 0.001$). Furthermore, gaze behavior was overwhelmingly more guided by semantic, rather than low-level visual features in active, as compared with passive viewing (ANOVA interaction: $p < 0.001$). Taken together, our results demonstrate that active viewing influences nearly every aspect of gaze behavior, from how we move our eyes to what we choose to attend to.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thanks for joining this virtual talk!
For a full description of our work, here is a link to our preprint: https://bit.ly/2MNr7wU
Contact: ajh.gr@dartmouth.edu
www.robertsonlab.com

Abstract ID: 1423

Color constancy in a Virtual Reality environment

Talk Presentation - *Topic area: Vision in Immersive Environments*

Raquel Gil Rodriguez[1] (raquel.gil-rodriguez@psychol.uni-giessen.de), Matteo Toscani[1], Dar'ya Guarnera[2], Giuseppe Claudio Guarnera[2,3], Florian Bayer[1], Karl Gegenfurtner[1]; [1]Justus-Leibig University, [2]Norwegian University of Science and Technology, [3]University of York

Previous work has shown that the more immersed the observer is in a scene, and the more natural the task is, the more stable color appearance is across changes in lighting. In the real world, color constancy can reach levels of near perfection. Even though some experiments have used such real environments, this it is extremely difficult, time consuming, and most often it is impossible to change particular aspects of the world. Recent developments in Virtual Reality technologies provide an opportunity to overcome these limitations. The experiments were performed using the Unreal Engine, and an HTC Vive Pro head mounted display (HMD). We carefully calibrated the 2 OLED displays in the HMD, ensuring linearity and additivity of the display primaries. We used Autodesk 3Ds Max to create two different photo realistic virtual environments. An indoor scene showed a typical office environment with two light sources, one above and one behind the participant. The outdoor scene showed a natural landscape with the sun is the main source of light. The observers' task (N=12) was to adjust the color of a test object until it appeared gray to them under five different illuminants. We used a Radiant X29 camera colorimeter, for independent colorimetric verification of every adjustment. We found that observers adapted their settings to the different illumination conditions. In the indoor environment observers reached high levels of constancy comparable to previous experiments. In the outdoor scene, we surrounded the test object, a rock, either by water or by grass. The observers' settings shifted accordingly towards blue for the water and green for the grass. Our experiments show that it is entirely feasible to color-calibrate virtual environments and thus achieve full control over the physics of the scene while maintaining the highest level of ecological validity.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Thank you for your interest in our work. If you have any questions or would like to speak with us about the project, please feel free to contact me
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Abstract ID: 1226

Icy road ahead – gaze during perturbed walking

Talk Presentation - *Topic area: Vision in Immersive Environments*

Karl Kopiske[1] (karl.kopiske@physik.tu-chemnitz.de), Daniel Koska[2], Thomas Baumann[1], Christian Maiwald[2], Wolfgang Einhäuser[3]; [1]Cognitive Systems Lab, Chemnitz University of Technology, [2]Research Methodology and Data Analyses, Department of Human Movement Science and Health, Chemnitz University of Technology, [3]Physics of Cognition Group, Chemnitz University of Technology

We can walk effortlessly across flat uniform terrain even when we do not pay much attention to it. However, most natural terrain is far from uniform, and we need visual information to maintain stable gait. Recent advances in mobile eye-tracking technology have made it possible to study the question how real-word terrain affects gaze, and thus sampling of visual information. Studies in natural environments have shown gaze patterns during walking to change depending on terrain. While natural environments are essential for studying walking under realistic conditions, they provide only limited experimental control. Moreover, extreme conditions, such as very slippery surfaces, cannot safely be tested. Typical laboratory setups, in contrast, are far from natural settings for walking. We used a setup consisting of a dual-belt treadmill, a 240° projection screen, floor projection, motion tracking, and mobile eye tracking to investigate eye, head and body movements during perturbed and unperturbed walking in a safe and controlled yet naturalistic environment. To simulate terrain difficulty, we repeatedly induced slipping by rapidly and unpredictably accelerating, on quasi-randomly selected steps, either of the two belts. Subjectively, these perturbations were experienced akin to “slipping on an icy surface.” N=24 participants completed four 5-minute blocks of walking during which slip perturbations of varying speed and frequency occurred, in addition to two blocks of unperturbed walking at beginning and end. We quantified how participants adjusted gait patterns following slips and found persistent distinct gaze patterns to emerge. These gaze patterns scaled with perturbation intensity (slip speed) and were mainly driven by head movements. Interestingly, head and eye movements were neither synchronous nor compensatory to each other, suggesting that both effectors contribute independently to altered gaze patterns during perturbed walking. Our data provide a first step towards experimental quantification of gaze-gait interactions in naturalistic yet fully controlled walking.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 559

The cost of utilizing working memory under natural constraints

Talk Presentation - *Topic area: Vision in Immersive Environments*

Melvin Kallmayer[1] (mel.kallmayer@gmail.com), Anna C. Nobre[1], Dejan Draschkow[1]; [1]Oxford Centre for Human Brain Activity, Wellcome Centre for Integrative Neuroimaging, University of Oxford, UK

Interacting with our surroundings involves the interpretation and storage of visual information, as well as the updating of visual representations of the environment. That is, active interactions in natural behavior are interlocked with visual memory and its associated cognitive mechanisms. When physical-effort demands are low, we use eye movements to delay the gathering of task-relevant information until just before it is required, rather than holding information in working memory. We investigated the role of increasing metabolic demands in the utilization of working memory for efficient task completion in a temporally extended block-copying task. Our aim was to quantify the cost of encoding and maintaining information in working memory to guide behavior by combining head- and eye-movement measurements in virtual reality as we parametrically manipulated the required locomotive effort of the task. Across a series of studies, participants sorted objects into provided templates under conditions requiring varying movement effort during the information maintenance stage of the task. We show that working memory usage increases as locomotion demands increase. Participants shifted from a pure on-line acquisition strategy when minor head movements were required to maintaining up to 4 items when full body rotations were necessary. This change in strategy is accompanied by intricate gaze dynamics during encoding and maintenance, which allows us to describe the shape of the relationship between locomotion effort and working-memory utilization, i.e. quantify the energetic cost of loading working memory. The utilization of cognitive resources is a cornerstone of ecological behavior, and we argue that it should be investigated under the light of available actions and by encompassing naturalistic complexities such as behavioral goals, locomotion, and object interaction, rather than ignoring them.

Acknowledgements: This work was supported by The Wellcome Trust 104571/Z/14/Z (to A.C.N.). The Wellcome Centre for Integrative Neuroimaging is supported by core funding from the Wellcome Trust (203130/Z/16/Z).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1034

The influence of pedestrian walking speeds on exit routes in real-world and immersive virtual environments

Talk Presentation - *Topic area: Vision in Immersive Environments*

Alexander P. Boone[1] (alexanderpaulboone@gmail.com), Bertrand H. Lemasson[2], Lucy Durand[1], Michael L. Mayo[3], Kevin R. Pilkiewicz[3], Margaret R. Tarampi[4], Kristen L. Macuga[1]; [1]Oregon State University, [2]Environmental Laboratory, U.S. Army Engineer Research and Development Center (ERDC), Newport, OR, [3]Environmental Laboratory, U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, [4]University of Hartford

Research has shown that the behavior of a bystander can influence decisions about whether or not to evacuate a room (Kinateder & Warren, 2016). Here, we investigated how neighboring pedestrian walking speeds influence exit choice and exit time using immersive virtual reality (VR), as well as a matched real-world condition for validation purposes. Forty-five participants performed a simple egress task in which they exited a room via one of two doors. Two other pedestrians were also present (avatars in VR and confederates in the real world). On each trial, the "variable" pedestrian walked towards one door by traveling at one of three average speeds (1.0m/s, 1.5m/s, or 2.0m/s), and the "constant" pedestrian walked towards the other door at a speed of 1.5m/s. Pedestrian exit door was counterbalanced, yielding six randomly presented trials in VR and six matched trials in the real world. The VR/real-world condition order was counterbalanced across participants. To start each trial, the two pedestrians began walking to their assigned doorway at their assigned speeds. Then, the participant was cued to exit the room. After the participant exited, all parties were instructed to return to the center of the room to begin the next trial. Results indicated a general bias to follow the faster pedestrian. Further, the variable pedestrian speed also significantly influenced exit time such that participants exited faster during the 2.0m/s trials and slower during the 1.0m/s trials. Effects were similar for VR and real-world conditions, validating the use of VR in this context. Together, these results suggest that bottom-up visual motion cues biased exit choice and exit time. The influence of top-down cognitive processes via individual strategy differences will also be explored. Future work will employ more goal-directed evacuation scenarios.

Acknowledgements: This work was supported by funding through the Environmental Quality and Installations Basic Research Program of the U.S. Army's ERDC to KRP, MLM, MRT, BHL, & KLM (project #17-111). APB was supported by an appointment to the DOD Research Participation Program administered by ORISE.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 388

The role of central and peripheral vision for search in VR environments

Talk Presentation - *Topic area: Vision in Immersive Environments*

Erwan David[1] (david@psych.uni-frankfurt.de), Julia Beitner[1], Melissa Vo[1]; [1]Scene Grammar Lab, Goethe University Frankfurt

During visual search we rely on peripheral information to direct our gaze towards probable targets and we use our central field of view to further analyse stimuli and make a decision. Here we investigated the role of both foveal and peripheral vision for search in a more natural setting where head and body movements were unrestricted and where participants could make use of their peripheral field of view past the macula. To achieve this, we implemented a gaze-contingent paradigm within a virtual reality headset to assess the importance of central and peripheral information when an extended field of view is available (more than 80 by 80 degrees), contrary to studies using a 2D screen stimulating a narrow surface of the retinal eccentricity. Participants were looking for target objects in realistic 3D-modeled indoor scenes with gaze-contingent central or peripheral masks of six degrees of radius (and a control condition without visual interference). We simulated scotomas independently per eye and measured the contributions of head and eye movements to visual search. Results show an increase in return saccades and target refixation rates in cases where central information was missing. Conversely, with a lack of peripheral information we observed an increase in forward saccades. With regard to search efficiency, we replicated previous results in 2D where guidance to the target was unaffected by a central scotoma, while a peripheral mask substantially reduced search efficiency. Contrary to results from 2D searches, central scotomas did not affect target decision time, implying a greater role for peripheral pre-processing of target identities when searching with an extended field of view. In general, we found that artificial scotomas strongly affect eye

movements while head movements are majorly reduced. Our observations demonstrate how visual attention is engaged across the entire field of view during immersive, real-world searches.

Acknowledgements: This work was supported by SFB/TRR 26 135 project C7 to Melissa L.-H. Võ.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1101

Visual Memory: Capacity, encoding

Capacity Limits in Visual Mental Imagery

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Cristina R. Ceja[1] (crceja@u.northwestern.edu), Steven L. Franconeri[1]; [1]Northwestern University

Previous visual working memory studies have shown that viewers can store the visual properties (typically, colors) of approximately 3-4 items at a time (Brady, Konkle, & Alvarez, 2011; Zhang & Luck, 2008). If viewers are asked to remember the locations of each color (by testing detection of color swaps instead of replacements), this capacity drops to 2-3 items (Alvarez & Thompson, 2009). If the items move, this capacity drops as low as a single stored color-location pairing (Horowitz, Klieger, Fencsik, Yang, Alvarez, & Wolfe, 2007; Saiki, 2003; Saiki & Miyatsuji, 2009). These previous tasks allowed the viewer access to an external display, in which the object and its features were readily available. But how would viewers fare when these objects need to be represented and manipulated endogenously with visual mental imagery? Would the same factors that limit capacity in visual working memory also limit visual mental imagery? To test the capacity limits of observers without online access to an object and its features, participants were asked to store colored circles (1-4 items), and imagine these circles translating or rotating (10, 60, 90, or 110 degrees). We then measured subjective task difficulty and objective change detection performance. Both measures suggest a capacity-limited system. Subjective responses indicated that updating color locations across transformations was more difficult with greater set sizes, for rotation transformations, and across greater distances, and objective performance worsened with an increase in set size. The capacity limiting factors found here in both the subjective difficulty ratings and objective change detection parallel those found in working memory, suggesting that visual working memory and visual mental imagery may share similar capacity constraints.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1704

Causal manipulation of activity in the ventral visual stream changes visual long-term memory storage

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Chong Zhao[1], Geoffrey Woodman[1]; [1]Vanderbilt Vision Research Center, Vanderbilt University

Modern theories of memory propose that the temporal cortex is critical for storing detailed visual long-term memory representations. Here we tested this idea by causally manipulating activity in the temporal lobe of human subjects performing a visual recognition memory task. Subjects were required to remember 500 pictures of common visual objects following 20 minutes of transcranial direct current stimulation (tDCS) applied to the temporal lobe (10/20 electrode T3 or T4) or following a sham procedure to which subjects were blind. First, we applied anodal tDCS and found that subjects' recognition memory performance was better than their sham baseline. Second, we applied cathodal stimulation and found that subjects' recognition memory performance was worse than their sham baseline. Third, to determine whether the memory enhancement effect was due to enhanced encoding or retrieval, we applied stimulation immediately prior to the visual memory test phase. This experiment showed no benefit of stimulation when applied prior to retrieval. Fourth, to understand the neural dynamics underlying the enhanced recognition memory performance, we recorded the subjects' electroencephalogram (EEG) and their averaged event-related potentials (ERPs) after anodal tDCS. We found that the stimulation-induced memory enhancement was accompanied by significant inhibition of alpha-band power as the pictures were encoded into visual long-term memory. Our findings provide causal support for the view that activity in the temporal lobe (i.e., the ventral visual stream) is essential for accurate storage of representations in visual long-term memory.

Acknowledgements: The present work was supported by the National Eye Institute (R01-EY019882, P30-EY08126, and T32-EY007135) and NIMH (R01-MH110378).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 105

Conceptual Cues Facilitate Encoding in Visual Working Memory

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Andrew Clement[1] (as.clement@utoronto.ca), Adrian Ng[1], Alison Chasteen[1], Jay Pratt[1]; [1]Department of Psychology, University of Toronto

A growing body of evidence suggests that viewing words with implicit spatial associations can facilitate the processing of information at compatible spatial locations. Like other types of spatial cues, these conceptual cues are thought to produce spatial shifts of attention. If this is the case, viewing words with implicit spatial associations should also facilitate the encoding and retrieval of information from visual working memory. To test whether this is the case, participants viewed a word with an upward (e.g., God, hat), downward (e.g., Devil, boots), or neutral (e.g., table, chair) spatial association, followed by an array of four colored squares. The colors of the squares could be selected from either a set of seven discriminable colors or a continuous color wheel. After a brief retention interval, a probe square was presented at the location of one of the four squares, and participants were asked to identify whether the color of this square was the same as the square that was originally at that location. To ensure that participants processed the central word, they were only asked to complete the visual working memory task when a non-furniture word was presented. Participants were faster at identifying the color of the probe square when it was presented at a compatible spatial location, suggesting that conceptual cues can influence the encoding of information in visual working memory. However, participants were also faster at identifying the color of the probe square when it was presented at a horizontal spatial location, suggesting that processing the central word may have involved lateral shifts of attention. Together, these findings indicate that viewing words with implicit spatial associations can facilitate the encoding of information in visual working memory, and provide further evidence that these conceptual cues may produce spatial shifts of attention.

Acknowledgements: This research was supported by an NSERC Discovery Grant.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1258

Examining encoding biases in visual working memory using alpha band activity

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Gisella Diaz[1] (gisella@uchicago.edu), Edward Vogel[1], Edward Awh[1]; [1]University of Chicago

Previous work has shown that statistical regularities can bias working memory encoding towards locations where targets are more likely to appear, even in groups of subjects that cannot report the likely target positions. Recent techniques using EEG and inverted encoding models have shown that the topography of alpha-band (8-12 Hz) activity can provide a sensitive index of where covert attention is oriented, as well as the positions of items stored in visual working memory. Thus, we examined whether this neural index of spatial selection would track the spatial bias towards likely target positions, or whether this bias taps into a mode of selection that is not indexed by alpha. Participants were briefly presented with a display of eight colored squares equidistant from fixation. After a brief blank delay, the squares reappeared. On half of the trials, all squares remained the same color. On the remaining trials, there was a change in the color of one of the squares. Unbeknownst to subjects, change trials had a seventy-five percent chance of occurring in one predetermined (dominant) quadrant, which was counterbalanced across participants. We replicated the finding that change detection performance was significantly higher for items in the dominant quadrant relative to items in the non-dominant quadrants, which suggests that memory encoding was biased towards the dominant quadrant. However, spatial tuning functions estimated using alpha activity did not reveal a bias towards the likely target locations during either pre-trial or delay period epochs, suggesting that this spatial bias is implemented by a distinct kind of visual selection, or that it reflects a bias in the efficacy of decision processes.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1248

Imagery and perception-based decoding of facial identity from EEG signals

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Dan Nemrodov[1] (dannem@gmail.com), Ilya Nudnou[1], Adrian Nestor[1]; [1]University of Toronto Scarborough Campus

Despite recent progress in unravelling the neurocomputational mechanisms for face perception, their counterparts, that subserve visual memory and imagery for faces, are yet to be elucidated. To address this challenge, here, we used electroencephalography (EEG) in healthy adults to assess the neural response elicited by familiar faces, as participants viewed or recalled their appearance in response to a cue. Specifically, we appealed to pattern analysis to decode the identity of famous female faces and to characterize the structure of face space from imagery and perception. The outcome of this investigation showed, first, that facial identity could be decoded from both perception and imagery. Second, the temporal profile of face decoding showed, for imagery, particular reliance on the interval between 1-2 seconds after cue onset while, as expected, this profile exhibited an earlier peak for perception, around 400 ms after stimulus onset. Third, despite their divergence in the temporal domain, imagery and perception were spatially similar in their reliance on parietal and centro-parietal channels for decoding purposes. Last, an assessment of representational spaces showed that imagery-based space structure could be explained to some extent, but not entirely, by its perceptual counterpart. Thus, the present findings shed light on the visual representations underlying face imagery, on their spatiotemporal dynamics and on their relation with perception. Moreover, methodologically, they demonstrate the ability of EEG signals to carry fine-grained information regarding visual memory and imagery for faces.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 311

Information about all items is actively held in mind when computing ensemble statistics about a set

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Jonathan M. Keefe[1] (jmkeefe@ucsd.edu), Igor S. Utochkin[2], Jonas S.H. Lau[1], Timothy F. Brady[1], Viola S. Stoermer[1]; [1]University of California, San Diego, [2]National Research University Higher School of Economics, Moscow, Russia

A large body of research on ensemble perception has shown that humans can effectively represent statistical summary information about features in the environment. However, it is unclear whether ensemble representations are the result of an effortless perceptual process or whether information must be actively held in mind when performing ensemble tasks. In order to distinguish between these possibilities, we had subjects perform three different tasks in a blocked design while recording EEG activity. Participants (N=20) were presented with bilateral displays of oriented triangles and asked to either remember 1, remember 4, or compute the average orientation of 4 triangles over a 900 ms delay. In order to test whether subjects were actively holding individual orientations in mind while calculating the mean orientation, and if so, how many, we compared the amplitude of the Contralateral Delay Activity (CDA) in each task: a slow-wave ERP that increases in magnitude as more information is held in mind (Vogel & Machizawa, 2004). Critically, we found a main effect of task upon CDA amplitude ($p < 0.001$), which was driven by a significantly smaller CDA amplitude when subjects were asked to remember 1 triangle vs. remember 4 or report the mean of 4 triangles ($ps < 0.001$). However, there was no difference between the CDA amplitude when subjects were asked to remember 4 or report the average of 4 orientations ($p = 0.91$, $BF01 = 4.3$), indicating that subjects were holding a similar amount of information in mind while performing each task. This result demonstrates that when computing summary statistics, rather than perceptually extracting a single mean during encoding and maintaining only that mean representation, information about all items is held in mind. Overall, this suggests that ensemble representations may be the result of actively maintaining information in neural populations of relevant sensory cortices.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Thanks for stopping by my poster! Please stop by one of my conference times if possible, as I would love to answer questions and discuss this project. If none of my conference times work for you, please send me an email at jmkeefe@ucsd.edu or a tweet at @JonathanMKeefe and we can find a time to meet (or message from there)!

Abstract ID: 1523

Neuromodulation of visual cortex reduces the intensity of intrusive visual emotional memories

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Noa Herz[1] (herz.noa@gmail.com), Yair Bar-Haim[1], Ido Tavor[1], Niv Tik[1], Haggai Sharon[2], Emily Holmes[3], Nitzan Censor[1]; [1]Tel-Aviv University, [2]Tel Aviv Sourasky Medical Center, [3]Karolinska Institutet

Aversive events are sometimes re-experienced as intrusive memories – i.e., involuntary and spontaneous retrievals of the aversive memory accompanied by significant distress. Intrusive memories are predominantly visual, and previous results suggest that the vividness of mental images is coupled with elevated visual cortex activity. Here, we tested whether neuromodulation of visual cortex following encoding of a “trauma” film could reduce the frequency and intensity of subsequent memory intrusions. Participants viewed a “trauma” film and were then requested to record each intrusive memory of the film during the ensuing 5 days. Leveraging memory reactivation frameworks according to which reactivation of an existing memory may enable its modification, one day following the trauma film watching participants’ memory of the film was reactivated by brief reminders, followed by 15 minutes of inhibitory 1Hz repetitive Transcranial Magnetic Stimulation (rTMS) over the visual cortex (visual-rTMS, n=19) or over a control site (vertex, n=21). Results indicate that visual-rTMS reduced the intensity of distress caused by memory intrusions. In addition, functional connectivity between visual and emotional resting-state brain networks measured using fMRI prior to film viewing suggests that interactions between visual and emotional processing areas determine the distress intensity of intrusive memories. Together, these findings point to potential neuroscience-driven interventions designed to downregulate the distress experienced by intrusive memories.

Acknowledgements: This work was supported by the I-CORE Program of the Planning and Budgeting Committee and the ISF (grants 51/11 and 526/17).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York

Presenter's Message

Hi! Please feel free to contact me and ask any questions: herz.noa@gmail.com
or: https://twitter.com/Noa_Herz

Abstract ID: 360

Representations of Meaningful Objects in Visual Long-Term Memory Have Greater Invariance and Resist Proactive Interference

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Patrick Garrigan[1]; [1]Saint Joseph`s University

Visual long-term memory is better when the encoded items are meaningful. Three experiments were conducted, each investigating why a representation that includes both visual and semantic content may increase VLTM performance. A behavioral calibration procedure was used to sort images of tools (broadly defined) into a familiar set (known function; both visual and semantic information available for encoding) and unfamiliar set (unknown function, mostly just visual information available for encoding). In all three experiments, participants viewed 50 images of objects (either familiar or unfamiliar) in sequence, and then completed a 2AFC memory test in which they were required to indicate which of two simultaneously-presented objects was previously shown. In the first two experiments, the hypothesis that meaningful, familiar objects are encoded in a format more invariant to incidental viewing conditions was tested. Experiment one showed that familiar objects are less affected by removal of color information between study and test. Experiment two showed that familiar objects are less affected by partial occlusion at test. The third experiment tested the hypothesis that visual memory representations of meaningful, familiar objects are more robust to proactive interference. Using a pre-exposure procedure, the results showed that familiar objects benefit from lower levels of interference, provided the interfering objects viewed during pre-exposure are not semantically similar to the test set. When the pre-exposure objects shared both visual and semantic information with the test set, performance for familiar objects decreased to the same level as the unfamiliar objects, suggesting that the advantage of additional semantic content was entirely lost. The results of all three experiments demonstrate how incorporating semantic information into memory representations enhances visually-guided recognition. Specifically, visual-semantic representations are more invariant to viewing conditions and less susceptible to proactive interference.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 23

Rethinking boundary extension as a universal phenomenon of visual memory

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Wilma A Bainbridge[1,2] (wilma.bainbridge@gmail.com), Chris I Baker[1]; [1]National Institute of Mental Health, [2]University of Chicago

Boundary extension—a memory distortion in which observers misremember a scene as containing visual information beyond its edges—is widely regarded as a universal effect in visual memory, reflecting our brain's automatic extrapolation of scene information. However, most studies of boundary extension exclusively focus on a narrow stimulus set of object-oriented images. In this study, we test 2000 participants on a recognition-based boundary transformation paradigm across a naturalistic set of images, consisting of 500 object-oriented images and 500 scene-oriented images. While the object-oriented images replicate previous boundary extension findings, the scene-oriented images show equal proportions of both boundary extension and the opposite effect of boundary contraction. The direction of boundary transformation is highly predictable from simple image properties: images with fewer, central, close and large objects tend to cause extension, while images with more, dispersed, distant, small objects cause contraction. Finally, these boundary transformation scores are highly consistent across paradigms (both rapid recognition and recall drawings), including a perceptual task with minimal memory load in which participants draw copies of images while viewing them with no time limit. Collectively, these results put into question boundary extension as a universal scene memory phenomenon, given that we observe boundary contraction for the most scene-like images, and that these effects occur even during minimal memory conditions. These findings also suggest alternate image-property-based accounts of scene transformation in the brain. Crucially, these results highlight the importance of revisiting already accepted psychological phenomena and the necessity to always consider broad, representative samples and images when making global inferences about the brain.

Acknowledgements: This research was supported by the Intramural Research Program of the National Institutes of Health (ZIA-MH-002909), under National Institute of Mental Health Clinical Study Protocol 93-M-1070 (NCT00001360).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Hello and welcome to our poster! Outside of the scheduled Zoom sessions, feel free to get in touch with me at wilma@uchicago.edu or @WilmaBainbridge on Twitter. You can also check out other work going on in the Brain Bridge Lab at University of Chicago at https://brainbridgelab.uchicago.edu/.

I recently gave a talk on this work at NeuroMatch 2.0. Please watch the talk if you'd like a run-through of the work! https://www.crowdcast.io/e/neuromatch2/55

Abstract ID: 829

Time course of decoding familiar people and places during visual recall from memory

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Anna Corriveau[1] (anna.corriveau@nih.gov), Alexis Kidder[1], Susan Wardle[1], Edward Silson[2], Chris Baker[1];
[1]National Institute of Mental Health, [2]The University of Edinburgh

Recall of familiar people or places elicits activation in distinct sets of cortical regions, including ventral temporal cortex, medial parietal cortex, and posterior parietal cortex. To investigate the temporal dynamics of visual recall from memory, we collected magnetoencephalography (MEG) data while participants (N=30) visualized highly familiar people or places requiring retrieval of long term internal representations. Conditions were personalized to each participant and they each provided the names of six personally familiar people (e.g. Aunt Sanika) and places (e.g. gym). In a retrocue paradigm, two names were presented sequentially on the screen (800 ms each with a 200 ms gap) followed by a blank screen (400 ms) and then the presentation of a retrocue (500 ms). This retrocue was either the number 1 or 2, indicating that the participant should visually recall either the first or the second item shown. Participants then visualized the cued item as vividly as possible for 4000 ms. Each condition was presented 32 times and cued 16 times over the course of 192 trials. Trials were broken into 8 runs in which each name was seen 4 times and cued for recall twice. Data was sampled across 272 channels at 1200 Hz with whole-brain coverage, then downsampled to 200 Hz. Principal component analysis was implemented to retain the components explaining 99% of the variance. Using both multivariate pair-wise classification and representational similarity analysis on the responses measured across sensors, we found significant decoding of people versus places starting around 900 ms after retrocue onset. This decoding persisted throughout the visual recall period. Further, we observed a tendency toward decoding individual people and places. These results demonstrate the ability to decode visual representations recalled from long term memory in the absence of any preceding visual stimulation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have any questions, please feel free to email me at anna.corriveau@nih.gov. If you are unavailable during the scheduled zoom calls, I am happy to schedule an alternate one-on-one meeting.

Abstract ID: 864

Using Deep Convolutional Neural Networks to Examine the Role of Representational Similarity in Visual Working Memory

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Fenil Doshi[1] (fenil_doshi@fas.harvard.edu), Hrag Pailian[1], George A. Alvarez[1]; [1]Harvard University

To what extent does representational similarity between items affect our ability to store them in visual working memory? This question has been addressed for simple perceptual features, such as color (Lin & Luck, 2009), but has been difficult to address for higher-level shape representations, where the nature of the feature space is unknown. Here we approach this challenge by leveraging deep neural networks to generate stimuli designed to produce maximal responses in higher-level primate visual cortex. This approach enables us to generate stimuli that vary in their degree of similarity in high-level feature space. To generate synthetic images that differentially drive V4 neural activity in a predictable fashion, we adapted the methods of Bashivan et al., (2019) who created a V4 encoding model by mapping AlexNet conv-3 activations onto macaque V4 activity. The complete differentiable nature of this image-computable model provides a means to extract gradients of artificial neurons with respect to image pixels (initialized as random noise), and modulate these pixels to maximize neural site predictions. Indeed, when presented to macaques, Bashivan showed that the resulting synthetic images increase activity of V4 relative to previously-best drivers of this area. Using Bashivan's encoding model, we generated a family of textures, estimated their predicted neural responses, and computed a representational dissimilarity matrix (difference in predicted neural response for all image pairs). We then had participants perform a change detection task, and measured whether it was easier to detect changes between images with higher predicted neural dissimilarity than images predicted to have more similar neural responses. Performance was consistent with the model predictions, such that change detection was more accurate for displays containing representationally distant vs. close images, $t(7)=-3.80, p<.01$. This neural-net guided approach may prove instrumental towards generating biologically plausible hypotheses of VWM architecture and its underlying constraints.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 11:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 149

Using Neurostimulation to Augment the Encoding of Information in Visual Working Memory

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

William Schmitt[1] (waschmitt@mgh.harvard.edu), Hrag Pailian[1], George A. Alvarez[1]; [1]Harvard University

Storage limits in visual working memory (VWM) impose an information-processing bottleneck, restricting input to broader cognition. Our capacity to store random, uncorrelated input is extremely limited (e.g., ~3 colors), but previous work has shown that more content can be stored if there are statistical regularities in the input (e.g., if pairs of colors tend to co-occur; Brady, Konkle, and Alvarez, 2009). Here, we used a novel non-invasive brain stimulation technique, trans-cranial random noise stimulation (tRNS), to enhance the learning of these regularities and consequently increase the amount of information retained in VWM. We presented three separate groups of participants with displays consisting of 8 colored circles, arranged in 4 concentric pairs. The colors disappeared, after which participants reported the identity of a cued circle by choosing from the 8 possible color-options. Participants in the “tRNS+Pattern” group received 20-minutes of neurostimulation to the right posterior parietal and right dorsolateral prefrontal cortices during the first 20-minutes of testing, and were also presented with displays containing regularities (i.e. 4 pairs of colors appeared together 80% of the time). Though the remaining groups of participants were connected to the neurostimulator, they did not receive stimulation. For these sham stimulation conditions, members of the “no tRNS-Pattern” group were also presented with displays with the same regularities, whereas color combinations for the “no tRNS-Uniform” group were sampled from a uniform distribution. Replicating the effects observed by Brady et al. (2009), “no tRNS-Pattern” participants were able to store more items in memory, relative to their “no tRNS-Uniform” counterparts. Critically, neuroenhancement effects were observed, such that members of the “tRNS+Pattern” group demonstrated the most superior performance. Performance across all groups plummeted to comparable levels when regularities were removed, reaffirming that the observed benefits reflect enhanced encoding. Neurostimulation may prove instrumental towards augmenting VWM and broader cognition.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 166

We don't learn from our mistakes: error-related arousal impairs subsequent memory formation

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Alexandra Decker[1] (alexandra.decker@mail.utoronto.ca), Amy S. Finn*[1], Katherine Duncan*[1]; [1]University of Toronto

Realizing that we've made an error triggers cognitive and behavioral adjustments, including increased arousal, attention, and more cautious responding (Jentzsch & Dudschig, 2009). These post-error adjustments are thought to boost task engagement and facilitate learning (Holroyd & Coles, 2002; Yeung, Botvinick, & Cohen, 2004). Yet, how errors affect memory encoding–a cognitive process foundational to learning–remains unknown. One possibility is that by increasing arousal and task engagement, errors would improve people's ability to encode information that comes next. Alternatively, errors might lead to too much arousal and/or attentional capture, impairing people's ability to encode information that comes next. In two experiments, we tested whether categorization errors influence how well people encode information presented after errors. In experiment 1, participants (n=60) categorized trial-unique images as 'living' or 'nonliving' and following a short delay, performed a surprise memory test. We found that people formed memories worse after categorization errors ($p<0.001$). In experiment 2, we investigated whether increases in arousal and/or attentional capture by errors contributed to post-error memory decrements in a separate cognitive control task. Participants (n=60) performed a modified Simon task in which they categorized trial-unique images as 'natural' or 'man-made', while we recorded pupil size and eye fixations and recognition memory for the images was later tested. Consistent with an arousal mechanism, individuals who displayed the largest increase in pupil size after errors had the greatest post-error memory decrements ($p<0.05$). Moreover, people with the largest post-error memory decrements tended to have better memory for the error trials and generated fewer fixations on post-error trials ($ps<0.05$) – consistent with the possibility that errors captured attention, leaving fewer encoding resources for information presented next. Our results suggest that rather than preparing people for learning opportunities, errors transiently impair memory encoding due to both increased arousal after errors and attentional capture by errors.

Acknowledgements: Brain Canada (Kids' Brain Health Network Award)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 5:00 am EDT America/New_York

Presenter's Message

Hi everyone! Welcome to my poster!! Please email me if you have any questions: alexandraleerdecker@gmail.com

Abstract ID: 524

We tallied the votes: No survival advantage in visual long-term memory

Poster Presentation - *Topic area: Visual Memory: Capacity, encoding*

Annie Truuvert[1], Jay Pratt[1], Susanne Ferber[1]; [1]The University of Toronto

It has long been known that depth of processing at encoding predicts later memory performance. One well-established encoding manipulation in the long-term memory (LTM) literature is survival processing, where LTM is significantly enhanced for objects that have been rated for relevance in survival scenarios compared to rating items for pleasantness. In LTM, this survival advantage has been found with object words as stimuli and surprise free recall tests; would a similar survival advantage be found for visual objects in visual long-term memory (VLTM)? To answer this question, participants rated coloured real-world object images in one of three conditions: softness, pleasantness, or relevance in a specified survival context. They then completed a surprise colour recall test, where they were shown greyscale versions of the object images and indicated each object's previous colour on a colour wheel. Mixture modelling was used to analyze the responses. Unlike the findings from LTM tasks, no survival advantage was found; objects rated for relevance in the survival scenario did not demonstrate greater resolution (i.e., precision, indicated by smaller standard deviation values of responses from the correct object colour) in comparison to the pleasantness or softness conditions. These results suggest that the survival advantage cannot be extended from its current status in the memory literature to that of VLTM. While encoding objects into LTM in a survival scenario context enhances retention, encoding objects this way into VLTM does not enhance the resolution nor the availability of the memory representation.

Acknowledgements: NSERC 2016-06359

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Apologies for the lack of closed captions. I am happy to provide a typed outline of what I say in my presentation video if you contact me at anne.truuvert@mail.utoronto.ca.

Abstract ID: 584

Visual Memory: Capacity, maintenance

Differences between online addition and subtraction in visual working memory

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Maya Ankaoua[1] (mayaankaoua@gmail.com), Roy Luria[1]; [1]Tel-Aviv University

Visual working memory (VWM) is responsible for both storage and processing of information. Nevertheless, most of previous research has focused on the maintenance part. While it has been shown that VWM devotes more capacity when maintaining more information, the current work investigated VWM capacity during mental subtraction and addition processes, while keeping the number of encoded objects constant. In the addition experiment, two shapes were presented. In the maintenance condition, participants were asked to press a key when they finished encoding and maintaining both shapes. In the addition condition, participants had to combine the two shapes into one integrated shape and press a key when this addition process was completed. Then, another shape was presented and participants were asked to indicate whether it was similar to one of the two initial shapes in the maintenance condition, or similar to the outcome of the integrated shape in the addition condition. Similarly, in the subtraction experiment, participants were asked to either maintain two shapes, or to subtract one from the other and maintain the result. We collected EEG data and used the Contralateral Delay Activity (CDA) as an indicator of VWM involvement. In both experiments, behavioral results showed that adding or subtracting was more difficult (longer RTs and lower accuracy rates) than just maintain the items. The CDA showed a higher amplitude both in the adding and subtracting conditions as compared to the maintenance condition. This suggests that while performing the addition or subtraction processes, more VWM is involved compared to when we simply maintain the same amount of information. This can be due to intermediate products we create and maintain while performing the addition or subtraction.

Acknowledgements: Minducate Center, Sagol School of Neuroscience

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 722

Evaluating the independence of working memory for scene layout and simple features

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Anna Shafer-Skelton[1], Timothy Brady[1]; [1]UC San Diego, Department of Psychology

A fundamental question in cognition is how our memory stores are structured. While neuroimaging evidence suggests that objects and the layouts of major surfaces (which we refer to as “scene layout”) may be processed separately, previous behavioral work has encountered mixed results in relation to working memory, possibly because this work has largely not isolated scene layout, instead using scenes that contain objects. To investigate scene layout vs. object memory stores, we measured dual-task costs when participants remembered three colored dots in addition to three other items: (1)a fourth, peripheral color; (2)the orientation of a peripheral gabor patch, (3)the layout of a full-screen background scene with no objects. We also collected single-task data for each of these three items on their own, attempting to match performance in these conditions. If object and scene memory rely on separate resources, remembering a scene should have a smaller cost to participants' color memory than remembering an additional color. In Experiment 1(N=27), performance in single-task conditions wasn't successfully matched, with higher performance in the extra-color single-task condition compared to orientation and layout. However, adjusting for this, we find preliminary evidence of similar dual-task costs to extra-scene vs. extra-object performance, meaning we find no evidence of more independence for color vs. scene memory stores compared to color vs. peripheral gabor or color vs. peripheral color. Contrary to other paradigms that find relatively independent storage of orientation vs. color (e.g., Wang et al.2016), we also find little independence for these features. In addition, a post-hoc analysis collapsing with an additional Experiment 2 in order to better match single-task performance finds similar results. Future work that matches single-task performance can better disambiguate these hypotheses and examine under what conditions orientation and color are independently stored, providing critical insight into the independence of scene and feature memory stores.

Acknowledgements: NSF GRFP awarded to AS and BCS-1653457 awarded to TFB

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 11:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1576

Increased overlaps across objects arising from reduced view-height impair visual short-term memory performance

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

YAGEUM KA[1] (ka7945@naver.com), JOO-SEOK HYUN[1]; [1]Chung-Ang University, Seoul, South Korea

Lowering observer's view-height may result in an increase of overlaps among objects in the visual field, making it difficult to identify those objects. Based on this possibility, this study presented an array of colored squares constructed according to its expected view from different heights, and examined visual short-term memory (VSTM) performance for those squares. In Experiment 1, the array was presented on the floor of a grid-patterned background providing a view of linear perspective. The size of each stimulus in the array was adjusted with respect to depth position of each square on the floor. In the three view-height conditions (high, middle, and low), lines of the background grids were arranged according to the view of linear perspective expected from each different view-height. Participants were asked to remember both colors and positions of the squares, and performed change detection of both features in two setsize conditions (3 vs. 6 items). We found an evident drop of change detection performance when the view-height condition was lowest in the setsize 6 condition. In Experiment 2, we ran the same change detection task with the same view-height manipulation as Experiment 1 except that the setsize was fixed to 6 items, and that the background grids were manipulated to be present or removed. While the removal of background did not influence change detection performance, overall performance dropped as the view-height became lower. The results demonstrate that lowering view-height of an observer can increase the amount of overlaps across objects in the visual field, and sensory interference arising from the increased overlaps can impair VSTM performance for the objects.

Acknowledgements: This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (2017R1D1A1B03033965).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 621

Long-term memory guides resource allocation in working memory

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Allison Bruning[1] (abruning@utexas.edu), Jarrod Lewis-Peacock[1]; [1]University of Texas at Austin

Working memory resources are incredibly limited yet every day we must maximize the goal-relevant information we encode from our environment. Working memory, however, is not in complete isolation. Prior knowledge in long-term memory can aide in maximizing the information we encode. Here we used a full-report procedure in a visual working memory paradigm to examine the influence of prior information on resource allocation in working memory. For each trial, six colored circles appeared at a random angle about a fixed radius. The location of five of the six colors was drawn from a uniform distribution ("non-prior" items), while the remaining color was drawn from a von Mises distribution with a standard deviation of 20 degrees ("prior" item). The color and mean of the prior distribution were randomly determined for each participant at the beginning of the experiment and remained constant. Participants first completed a training phase where they were explicitly shown and tested on both the color and location of the prior distribution. For the remainder of the experiment, participants reported the locations of all six colors in any order on each trial. To verify participants maintained the prior information, they were tested on the color and location of the prior item at the end of each run. We found that participants allocated fewer resources to the prior items, as evidenced by 1) a bias to report the prior item later in the response sequence (typically 4th of 6 positions), and 2) a decrease in precision for reports of non-prior items that appeared near the prior location. Together these findings show that participants are using strategies to prioritize encoding items with no prior information. These results give us a better understanding of how working memory may rely on long-term memory to strategically encode information from our environment.

Acknowledgements: EY028746

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1619

Perceptual distraction disrupts control over visual memory encoding

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Blaire Dube[1] (dube.25@osu.edu), Andrew B Leber[1], Julie D Golomb[1]; [1]The Ohio State University

Given the complexity of our visual environments, a number of mechanisms help us prioritize goal-consistent visual information. When crossing the street, for instance, attention is constrained to relevant information, such as the crossing signal and position of a nearby vehicle. This relevant information can then be encoded into visual working memory (VWM) and used to guide behavior. The efficient use of these inherently capacity-limited mechanisms relies on filters that restrict irrelevant information from visual selection and VWM encoding. What happens to these filters when attention is captured by a distractor? Although the effects of attentional capture on response times are heavily studied, we know little about its broader consequences: we may take longer to locate the crossing signal, but we may also fail to encode the nearby vehicle. Does distraction also disrupt the filter that controls VWM encoding such that irrelevant distractor features are unnecessarily encoded? Participants performed two consecutive visual search tasks on each trial. In the first (S1), they located a target (T) among non-targets (Ls), all presented within colored squares. On 40% of trials, a distracting white border flashed briefly surrounding a non-target square—we hypothesized that the (task-irrelevant) color associated with this S1 salient distractor would be encoded into memory, thus impacting later search. In the second search (S2), participants located a uniquely oriented landolt-C stimulus. The S2 items were all white, except one colored singleton distractor; critically, its color sometimes matched a color from the S1 display, including the salient distractor. We observed exacerbated response time slowing (consistent with memory-driven capture) in this critical S2 condition relative to when the singleton matched an S1 control item color. We propose a novel Filter Disruption Theory: distraction disrupts the filter that controls access to VWM, resulting in the encoding of irrelevant inputs at the time of capture.

Acknowledgements: NIH R01-EY025648 (JG), NSF 1848939 (JG and AL)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Thanks for coming by! If you have any questions, please feel free to contact me at dube.25@osu.edu, or find me on Twitter at @BlaireDube.

Abstract ID: 859

Prospective task knowledge improves working memory-guided behavior

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Frida Printzlau[1] (frida.printzlau@stcatz.ox.ac.uk), Nicholas Myers[1], Paul Muhle-Karbe[1], Sanjay Manohar[1], Mark Stokes[1]; [1]University of Oxford

Working memory (WM) is the ability to keep information online for a forthcoming task. WM theories have tended to focus on how sensory information is maintained, and less on how WM content is used for guiding behaviour. Here we ask if WM is supported by a transformation of sensory memoranda into task-sets that are optimised for task-dependent responses. Thirty participants performed two different WM tasks; they remembered the tilt of oriented bars for either a rotation-discrimination task or a change-detection task. Task context was instructed either in advance (fixed task blocks) or at probe onset (mixed task blocks). If WM content is configured in a task-dependent format, performance should benefit from foreknowledge of the upcoming task. In line with this prediction, we found that WM accuracy was higher when participants had advance knowledge of the task context. Even if WM content can be configured as a task-set, perhaps only one item is optimised for guiding behaviour. If so, retro-cued prioritization may be supported by a transformation of the selected item from a sensory to a task-oriented code. We included a retro-cue on half of the trials to test the second hypothesis that task-foreknowledge enhances retro-cued prioritization. Interestingly, the benefits of task foreknowledge were independent of the benefits incurred by retro-cueing, indicating that attentional selection is sufficient for prioritization of WM content. Together, these results provide preliminary evidence that WM coding may be task-dependent, but neuroimaging studies are needed to elucidate the precise mechanisms by which task foreknowledge facilitates WM-guided behaviour.

Acknowledgements: UKRI Biotechnology and Biological Sciences Research Council

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

If you're unable to attend any of the presentation slots, I'm also happy to chat offline. You can contact me on frida.printzlau@biodtp.ox.ac.uk.

Abstract ID: 1024

Recognition-induced memory bias (RIMB) in visual working memory

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Keisuke Fukuda[1,2] (keisuke.fukuda@utorono.ca), April Pereira[3], Joseph Saito[1], Hiroyuki Tsubomi[4];
[1]University of Toronto, [2]University of Toronto Mississauga, [3]University of Waterloo, [4]Toyama University

Visual memories can be altered long after they are encoded by biasing the context in which they are retrieved (e.g., Frenda, Nichols, & Loftus, 2011). However, it is not clear whether visual memories that are just encoded and actively represented in mind (i.e., visual working memory, or VWM) are also vulnerable to such change by biasing the context in which they are accessed. To test this, we had young adults perform a VWM task in which they remembered one simple object (e.g., a colored circle) over a 5-second retention interval. The precision and confidence of their memory were assessed immediately after the retention interval. During the retention interval in the critical condition, participants performed two-alternative-forced-choice (2AFC) recognition tests in which they judged which of the two recognition probes were more similar to the original memory item. The results showed that this simple recognition judgment was enough to bias the immediate recall of the original stimulus toward the recognition probe that was judged to be similar. Interestingly, this recognition-induced memory bias (RIMB) was observed even when participants reported high confidence in their accuracy of recall, indicating that participants were not fully aware of RIMB. In Experiment 2, we presented a single recognition probe to test whether the RIMB was the result of the attraction bias toward the similar recognition probe or the repulsion bias from the dissimilar probe. Here, the results revealed that it was the attraction bias. Furthermore, RIMB occurred only when the physically-identical probe was judged to be similar but not when it was judged dissimilar. Taken together, despite its active representation status, VWM can be implicitly attracted toward a new visual input when it is judged to be similar.

Acknowledgements: This work was supported by an NSERC Discovery Grant awarded to KF (RGPIN-2017-06866).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

Please note that the title of our poster has been updated to "Working memory paradox: Using working memory distorts working memory" in order to reflect the progress in our project since the abstract submission.

Please also check poster 1261 and 218 for highly-relevant projects!

Abstract ID: 1296

Retroactive interference with working memory consolidation: Visual, verbal, or central processing?

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Brandon J. Carlos[1] (bjcarlos@uh.edu), Benjamin J. Tamber-Rosenau[1]; [1]University of Houston

The speed by which information from vision is transformed into a working memory (WM) representation that is resistant to interference from ongoing perception and cognition is the subject of conflicting results. Using a dual-task retroactive interference (RI) approach, Nieuwenstein and Wyble (JEP:General, 2014) showed that WM consolidation is a slow process that continues for up to 1 s, even after a visual mask—contrary to previous, more rapid, estimates. Recent research using the RI approach has shown that the slow rate of WM consolidation is a structural limit (Carlos, Santacroce, & Tamber-Rosenau, OPAM, 2019). However, a major caveat to this research is that it has largely used visually-presented letter WM arrays. Thus, it is ambiguous whether slow consolidation is a visual WM, verbal WM, or central processing phenomenon. A single experiment by Nieuwenstein and Wyble (2014) demonstrated slow consolidation for a visuospatial WM item (an unfamiliar Kanji character), but the bulk of recent studies of WM storage capacity use color patches or other single-feature items. To determine if results from the RI/WM consolidation paradigm stem from the very same WM system as familiar storage capacity limits, we used a dual-task RI approach to evaluate the speed of WM consolidation for color patches. Replicating prior results with letter arrays, we observed an interaction between delay duration and the presence of a second task ($p = .01$, $\eta p^2 = 0.26$). Moreover, when compared to letter array results, the delay x second task interaction was not different across WM array types ($p = .44$, $\eta p^2 = 0.03$, BF10 = 0.150). The most parsimonious explanation of these results is that RI with WM consolidation stems from a central processing limitation that is involved in the consolidation of verbal, complex visuospatial, and simple color patch WM arrays.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1260

Using the continuous-report task to measure visual memory precision is relatively immune to motor noise

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Christina G. Rosca[1] (christina.rosca@vanderbilt.edu), David Sutterer[1], Geoffrey F. Woodman[1]; [1]Vanderbilt University

The color wheel continuous-report task has frequently been used to study visual working memory and the nature of its capacity limits. This task requires fine motor control, typically with a mouse, with the precision of responses being interpreted as due to the nature of memory representation, but without regard to the contribution of noise from the response effectors (i.e., the hand). Here, we tested the hypothesis that motor noise contaminates our estimates of visual memory representations in the continuous-report task. To test this hypothesis, subjects were asked to complete the color wheel continuous-report task, using either their non-dominant or dominant hand on different blocks of trials. Subjects reported the color of a single probe object on each trial, while we varied the set size of to-be-remembered colored squares from 1 to 4 randomly across trials. When comparing dominant hand to non-dominant hand performance across set sizes, the only significant difference we discovered was in reaction time. We found that subjects took significantly longer time to complete the task with their non-dominant hand, but this did not affect error rates in reporting. Our findings suggest that this commonly used task to study visual memory is relatively immune to contamination from motor noise at the output stage, thus demonstrating the potential of the task to study memory mechanisms in patient populations.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 747

Visual memories can recover from recognition-induced memory biases

Poster Presentation - *Topic area: Visual Memory: Capacity, maintenance*

Joseph Saito[1] (joseph.saito@mail.utoronto.ca), Keisuke Fukuda[2]; [1]University of Toronto, [2]University of Toronto Mississauga

How do we retain accurate visual memories over a long time? Studies have demonstrated that successfully retrieving a memory increases the likelihood that it can be retrieved later. However, other studies shown that information provided during retrieval can alter how the original memory is reported (i.e.,

misinformation effect). These seemingly-contradictory findings suggest that retrieval calls the memory into a malleable state where it is augmented or modified by information available at that time. To test this, we first had participants encode 240 pictures of colored real objects. Then, memory for those objects was tested in two types of retrieval tasks (i.e., the recognition bias task and the baseline recall task) on the same day and the day after. In the recognition bias task, participants were first presented with a grayscale object image and indicated whether or not they remembered encoding its colored version. Subsequently, participants completed a two-second-long recognition practice in which they saw two colored versions of the same object and identified the one more similar to the encoded version. Participants then recalled the encoded object's color. The baseline recall task was identical, except for the recognition practice, which was replaced by a two-second blank retention interval. We found that irrespective of retrieval type, memories retrieved on Day 1 were more likely to be retrieved on Day 2 than memories not tested on Day 1. Additionally, recall following recognition practice was biased towards the probe judged to be more similar to the encoded object. Interestingly, however, this recognition-induced memory bias was transient and did not influence memory recall on Day 2. Taken together, these data support our hypothesis that retrieval brings visual memories into a malleable state to be augmented or altered by memory-relevant information. Fortunately, recognition-induced memory biases may not permanently change the encoded representation.

Acknowledgements: This work was supported by an NSERC Discovery Grant awarded to KF (RGPIN-2017-06866)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York
23 June, 6:00 pm EDT America/New_York

Presenter's Message

Please note that the title of the poster has been updated to "Perceptual Comparisons Induce Lasting Memory Distortions" to reflect developments in the project since the original abstract submission.

See posters 1296 and 218 for other highly-related projects.

Please consider following my other academic musings on Twitter @jsaito25

Abstract ID: 1261

Visual Memory: Capacity, representation

Dynamic Representations in Visual Working Memory

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Ben Park[1,3] (benedict.park@mail.utoronto.ca), Dirk B. Walther[1,2], Keisuke Fukuda[1,3]; [1]Department of Psychology, University of Toronto, [2]Samsung Artificial Intelligence Center Toronto, [3]Department of Psychology, University of Toronto Mississauga

Despite people's subjectively rich visual experiences, the amount of information they can actively represent in their minds at a given time is severely limited by the capacity of visual working memory (VWM). To characterize this cognitive bottleneck, past studies have primarily employed static visual stimuli and, therefore, it is not yet clear how VWM represents dynamically changing visual information. Previous research suggests that VWM might utilize two distinct mechanisms to maintain an active representation of a changing stimulus: When a stimulus goes through a continuous (e.g., gradual) change, VWM keeps up with the change by updating its existing representation of the original stimulus. When a stimulus goes through a discontinuous (e.g., sudden) change, VWM resets its content by first discarding its original representation of the stimulus and then re-encoding a new representation. To test this hypothesis, we measured an electrophysiological correlate of VWM load (the contralateral delay activity or CDA) while participants tracked the characterizing identity (e.g., shape, color) of a dynamically changing stimulus. Here, we predicted that 1) the CDA amplitude remains sustained when a target object goes through a continuous identity change and 2) the CDA amplitude reduces to zero shortly after a target object goes through a discontinuous identity change. Our experiments confirmed both of our hypotheses when the stimulus went through dynamic shape or color changes. Taken together, our findings provide support for the existence of two distinct mechanisms through which VWM keeps track of dynamically changing visual information; updating and resetting.

Acknowledgements: This work was supported by an NSERC Discovery Grant awarded to KF (RGPIN-2017-06866)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York

Presenter's Message

Notes: By 'active capacity in visual working memory', I mean the current load in visual working memory. Sorry for any confusion.

Presenter conference time: June 23 @ 5pm EST

Join Zoom Meeting:
https://us04web.zoom.us/j/8449730422?pwd=Rkp6RUhSTWovVndKdlgvNFpJRWJTZz09

Meeting ID: 844 973 0422
Password: dynamic

Abstract ID: 900

Hierarchical representations in visual working memory are space-based

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Vladislav Khvostov[1] (hvo100v@mail.ru), Igor Utochkin[1], Timothy Brady[2]; [1]National Research University Higher School of Economics, Moscow, Russia, [2]University of California San-Diego, USA

It has been shown that the recalled size of an individual item is systematically biased towards the mean size of the set in visual working memory (VWM), suggesting hierarchical encoding (Brady & Alvarez, 2011). Here, we investigated whether hierarchical representations in VWM are spatially local or spatially global. We showed participants six circles of various sizes. The circles were spread across two quadrants aligned vertically or horizontally relative to eye-tracked fixation, with three circles per quadrant. Unbeknownst to participants, the mean sizes differed between the quadrants (the size gradient was masked by irrelevant filler circles). For each particular display, we tested memory for exactly the same circle size twice: when it was presented in a quadrant with a larger mean size vs. a quadrant with a smaller mean size. We calculated the bias towards the quadrant mean by computing the ratio of observer's responses to the tested item in these two responses. Although participants were unaware of the mean size manipulations across quadrants, we found a strong bias toward the quadrant mean in both vertical and horizontal alignments. In Experiment 2, we investigated whether this effect is quadrant-based or caused by any neighboring items. We tested a circle near a between-quadrant meridian in half of the trials. On these trials, the mean sizes of the two same-quadrant circles were always opposite (relative to the target item) those of the two nearest circles from a different quadrant, such that taking into account the entire local region of the target would result in no bias in any direction. The results showed the same strong bias toward the own quadrant mean in both horizontal and vertical alignments. Overall, the experiments showed that hierarchical representations in VWM are substantially space-based with a specific role played by horizontal and vertical meridians of the visual field.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

khvostov.vladislav@gmail.com

Abstract ID: 351

Lingering population codes: Serial dependence in working memory reports as evidence for population-based memory representations

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Isabella C. DeStefano[1], Timothy F. Brady[1]; [1]University of California San Diego, Dept. of Psychology

Information in visual working memory is influenced by irrelevant past information such that reports show a bias towards the remembered feature values of previous trials (Fischer & Whitney, 2014). Here, we propose that such serial dependence can be understood by considering working memory representations as distributed (population-based or probabilistic representations; e.g., Schurgin et al. 2018; Bays, 2014), rather than as point representations. In this framework, the previous trial causes lingering activity across all sensory channels (e.g., all colors) that influence the current trial. This predicts how both the strength of the activity from the previous and current trial as well as the population overlap (i.e. feature similarity) will affect the degree of serial dependence. We used experiments with both color and orientation to test these predictions. Fifty participants were asked to reproduce a single stimulus after a short delay. On each trial, we induced either a high or low strength memory via encoding time/masking manipulations. The order of trials was such that memory strengths and the distance in feature space between subsequent stimuli was balanced within-subject. As expected, memory strength of the current trial affected dependence on the previous trial such that this dependence was larger for low memory strength trials. We also found an interaction between the current trial strength and the feature similarity between subsequent trials: dependence on the previous trial for strong memory trials only occured when the subsequent stimuli were dissimilar; conversely low memory strength trials showed stronger dependence on the previous trial when subsequent stimuli had high feature similarity. These experiments suggest that serial dependence can be explained by a mechanistic account of visual working memory that represents both memory strength and feature similarity in terms of distributed population activity.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1557

Memory as Tinted Lens: Working Memory Contents Distort Perception

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Hyung-Bum Park[1] (hpark053@ucr.edu), Weiwei Zhang[1]; [1]University of California, Riverside

Although visual working memory (VWM) is often studied in isolation in laboratory research, maintaining and processing of information in VWM tends to occur concurrently with perceptual encoding of new sensory inputs in natural vision. It is unclear how much influence the existing VWM contents have on ongoing perceptual encoding. The present study aims to test the effects of VWM on visual appearance during ongoing perceptual encoding. Participants performed a single-item color change-detection task. A perceptual task was inserted into the maintenance interval of the change-detection task as a secondary task. In the perceptual matching task, a perceptual target color appeared at the center of display until the participants matched its color on a continuous 360 degree color-wheel using mouse clicking. Critically, the perceptual target color was either 40 degree clockwise (CW) or counterclockwise (CCW) from the memory color. The preliminary findings indicated that the perceived color shifted toward (i.e. attraction) the remembered color. First, the circular mean of reported perceptual color and its direction was shifted toward the location of the memory item (e.g. CW or CCW). Second, using an extended Zhang & Luck mixture model with Maximum Likelihood and Hierarchical Bayesian approach, we found a robust attraction effect with minimal effect of guessing and misreport. Third, change detection performance was impaired when the changed color was in the direction of the perceptual color shift. Lastly, mouse trajectory initiated from the display center to the reported color on the color wheel for the perceptual task systemically curved toward the remembered color in VWM. Furthermore, the time-course of the mouse trajectory showed an initial obligatory VWM-based feature guidance and the subsequent redirection of response to the perceptual target. Together, these results support the idea that VWM representations directly interact with ongoing perceptual encoding, leading to distorted perception.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for visiting our poster!
Any feedback or comment will be more than welcome.
Hyung-Bum Park (hpark053@ucr.edu).

Abstract ID: 1494

Neuronal ensembles of primate Lateral Prefrontal Cortex encode spatial working memory in different frames of reference

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Rogelio Luna Almeida[1,2] (rluna@uwo.ca), Megan P. Roussy[1,2], Adam Sachs[3], Stefan Treue[4,5], Julio C. Martinez-Trujillo[1,2]; [1]Robarts Research Institute, University of Western Ontario, [2]Schulich School of Medicine, University of Western Ontario, [3]Brain and Mind Research Institute, University of Ottawa, [4]German Primate Center, Germany, [5]Bernstein Center for Computational Neuroscience, Germany

Single neurons of the Lateral Prefrontal Cortex (LPFC) of macaques can encode spatial working memory (WM) signals. However, it is not fully understood whether ensembles of potentially interconnected neurons encode locations based on different reference frames during spatial WM. We trained two rhesus monkeys on an Oculomotor-Delayed Response task that allowed us to dissociate the memorized spatial locations between a screen-centered (spatio-topic) and a retino-centered (retino-topic) reference frames. The monkeys fixated a dot that appeared at one of 16 positions on the stimulation screen. Then a cue stimulus appeared at a different position for 1000ms. The animals kept looking at the fixation dot for another 1000ms (WM delay) and upon its removal they made a saccade to the memorized target location. Liquid reward was delivered for correct responses. We recorded the extra-cellular activity of single- and multi-units by implanting multi-electrode arrays dorsally (dLPFC) and ventrally (vLPFC) from the principal sulcus (areas 8A and 9/46), respectively. We computed the average firing rate during the WM delay for each unit and trained a linear classifier to decode the visual quadrant that included the memorized cue position in on every trial. Next, we constructed neuronal ensembles of different sizes (i. e., n = 2, 3… 88) and decoded the memorized quadrant from each ensemble. We found that best decoding accuracy for individual dLPFC and vLPFC neurons equaled 45% in the retinotopic reference frame and 40% in the spatiotopic. In contrast, best decoding accuracies yielded by ensembles of dLPFC and vLPFC cells equaled 69% and 79% in the retinotopic reference frame, respectively, and 55% and 52% in the spatiotopic reference frame. Interestingly, best decoding accuracies corresponded to ensembles sizes from ~10 to 20 neurons. Neuronal ensembles of LFPC could encode locations during spatial WM in both reference frames by using a population-based dynamic.

Acknowledgements: Natural Sciences and Engineering Research Council of Canada (NSERC) and Canadian Institutes of Health Research (CIHR)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Feel free to contact me if you have questions or comments:
- By clicking in the Chat button above, or
- You can send me an email to rluna@uwo.ca

Thanks for your interest, enjoy the V-VSS, and stay safe!

Abstract ID: 1753

Size matters – larger images are unintentionally better remembered

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Sharon Gilaie-Dotan[1,2] (shagido@gmail.com), Shaimaa Masarwa[1], Olga Kreichman[1]; [1]School of Optometry and Vision Science, Faculty of Life Science, Bar Ilan University, Ramat Gan, Israel, [2]Institute of Cognitive Neuroscience, UCL, London, UK

We are constantly exposed to many images, and although we do not actively try to remember or encode them, some of them are remembered. It has been suggested that such non-intentional memory is influenced by the depth of processing, but it is yet unclear what precisely defines the depth of processing for visual images. Here we reasoned that bigger images may entail deeper level of processing and may thus be remembered better than smaller ones. We ran a series of five studies (n= 91, each person participated in only one study) where each study started with an exposure experiment followed by a memory assessment experiment. To mimic non-intentional memory, in the exposure experiment participants were only instructed to freely view the images without being informed about any proceeding task. In this experiment they were exposed to hundreds of photographs of different categories and different sizes (3x3 to 24x24 vis. deg.). Following this, in the memory assessment experiment, each participant was shown a set of images of intermediate size (~8x8 vis. deg.), only half of them presented earlier, and for each image was asked to report if she/he recall seeing it earlier or not. We found that across experiments, larger images were incidentally remembered better, and this was true regardless of order effects, image set, or spatial resolution. While it is clear that multiple factors affect image memorability during incidental exposure, here we found that the physical dimension of image size seems to play an important role in this process.

Acknowledgements: Israel Science Foundation to SGD (No. 1485/18)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
21 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1779

Spatial working memory performance is similar for simple stimuli and real world objects

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Kelvin Lam[1] (kelvinlam@ucsb.edu), Thomas Sprague[1]; [1]University of California, Santa Barbara

Much of what we know about visual working memory has been uncovered using simple stimuli such as colored squares, but recent studies have suggested that alternative conclusions can be drawn using different stimuli, such as real world objects. For instance, visual working memory capacity has been estimated to be higher for images of real-world objects than for colored squares (Brady et al, 2016; Asp et al, pp2019; but see Quirk & Vogel, VSS 2017). A possible explanation as to why these differences exist is because objects are redundantly coded broadly across several brain regions, where simple stimuli like colored squares are encoded in a more limited set of regions. Because of this redundant coding, it could be that incidental features of complex objects, like their spatial position, are represented with greater precision, since multiple spatial representations across brain regions may average out (Foster et al. 2017). We tested this possibility with a delayed spatial recall task in which participants remembered arrays of either real world objects or colored squares. Participants (N=11) maintained the precise spatial position of 1, 2, or 6 visual stimuli over a brief 1.5s delay period. Stimuli were either images of categorically-distinct real-world objects (courtesy of Brady et al. 2008), or easily-discriminable colored squares. Contrary to our predictions, participants recalled spatial positions with equivalent precision in the two stimulus conditions. Moreover, in separate trials where participants discriminated which of two stimuli appeared at a probed location, performance was again identical between stimulus conditions. Altogether, these results do not support the notion that incidental features of real-world objects, such as their spatial position, can be remembered with greater precision than those for simplistic stimuli typically used in laboratory tests.

Acknowledgements: Sloan Research Fellowship (TCS)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1618

The role of familiarity in determining visual working memory capacity

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Yael Schems Maimon[1] (yael.schems@gmail.com), Roy Luria[1]; [1]Tel Aviv University

Visual working memory (VWM) has a very limited capacity. There is an ongoing debate whether this limitation depends on the number of items that can be maintained, or it is better explained by the complexity of the maintained items, such that complex items consume more capacity relative to simple items. Recent work has argued that complexity is often confounded with familiarity, and demonstrated that familiarity also affects VWM capacity allocation, regardless of their complexity, such that unfamiliar objects consume more capacity. However, these findings where specific to experts with the complex memoranda used in the experiment, and used face-like stimuli. In the current study, we further investigated the role of familiarity in determining VWM capacity allocation, by directly manipulating the level of familiarity. In two experiments, subjects performed a change detection task in which they had to maintain simple colors, familiar music instruments and unfamiliar (exotic) music instruments. The results of the first experiment confirmed the role of familiarity in VWM: familiar objects (colors and familiar instruments) led to a better performance, compared to unfamiliar instruments, although the visual complexity of both instrument-types was similar. In Experiment two, subjects were taught for 4 sessions various details about the unfamiliar instruments and performed the change detection task before and after the learning phase. Importantly, the learning phase did not include any specific VWM-related practice. Results indicated that learning about the instruments, that is the familiarisation with them, enhanced VWM performance. Based on both experiments, we concluded that familiarity with the objects have crucial role in determining visual working memory capacity limitations, over and beyond the object complexity. Additionally, the results further highlight the interactions between long-term memory and working-memory.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1092

Tracking spatial and non-spatial working memory representations coded in human oscillatory brain activity

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Kamryn Waldrop[1], Tom Bullock[1], Mary MacLean[1], Barry Giesbrecht[1]; [1]UC Santa Barbara

The spatial distribution of alpha-band activity across the scalp measured by electroencephalography (EEG) can be used to track specific spatial representations of stimuli held in working memory (WM; Foster et al. 2016; MacLean et al. 2019). Here, we tested the extent to which spatially specific information is maintained in WM when it is no longer task-relevant. Participants (n=7) performed a simple delayed recall task in which a circular stimulus was briefly presented (250ms) at locations on an imaginary circle around fixation. After a retention interval (1750 ms), participants recalled the task relevant feature of the initial memorandum. In different blocks, participants recalled either the stimulus location (requiring maintenance of spatial information during the retention period) or color (maintenance of spatial information not required) while EEG was recorded. Precision was lower when recalling color compared to spatial location ($p<.05$) and guess -rates were not different ($p>.05$). We used an inverted encoding analysis using EEG alpha power to estimate the spatially selective response throughout the trial. The spatially selective response was quantified using the slope of the response profile. We observed a robust stimulus representation (greater positive slope) during the stimulus presentation phase of the trial in both the spatial and color WM conditions. This was followed by a sustained spatially specific response in the spatial memory condition throughout the entire 1750 ms retention period, whereas in the color memory condition the spatially specific representation was maintained for ~750 ms post-stimulus. Together, these effects demonstrate that spatial information is encoded in the alpha band in combination with other task-relevant features, but this information degrades if spatial location is task-irrelevant.

Acknowledgements: URCA Grant and US Army Contract W911NF-19-0026

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1724

Using decoders to understand working memory representations of 3D space in primate prefrontal neuronal ensembles

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

MILAD KHAKI[1] (mkhaki@uwo.ca), MEGAN ROUSSY[1], NASIM MORTAZAVI[1], ROGELIO LUNA[1], ADAM SACHS[2], JULIO MARTINEZ-TRUJILLO[1,3]; [1]UNIVERSITY OF WESTERN (ONTARIO), [2]UNIVERSITY OF OTTAWA, [3]BRAIN AND MIND INSTITUTE

Neurons in the primate lateral prefrontal cortex (LPFC) encode and maintain WM representations in the absence of external stimuli. Neural computations underlying spatial WM in primates are traditionally studied using highly controlled tasks consisting of simple 2D visual stimuli and require a saccadic response. Therefore, there is little known about how populations of LPFC neurons may maintain and transform 3D representations of space for animals to navigate towards remembered object locations. To explore this issue, we created a spatial WM task that takes place in a 3D virtual environment. In this task, a target is presented in one of nine locations in the virtual arena. The target disappears during a two-second delay period, and then the subject is required to navigate to the remembered location using a joystick. Neural recordings were conducted in two male rhesus macaques using two 10×10 Utah arrays located in the LPFC (area 8A), resulting in a total of 3847 neurons. Using a novel high-efficiency classification technique, we decoded the target location on a single trial basis during different trial epochs. This method resulted in high decoding accuracy using a minimum number of neurons containing the greatest amount of target-specific information. Ensembles of 8-12 neurons resulted in 60%-90% decoding accuracy (chance= ~11). Importantly, we were also able to decode trial outcomes (correct or incorrect). Furthermore, to elucidate the underlying mechanism in which neural ensembles encode and maintain target locations in 3D space, we decoded each 3D location based on depth and direction (i.e. front, middle, back, right, center, and left). The results indicate that target direction and depth were retained with similar accuracy by neural ensembles. Moreover, we show that LPFC neurons vary in the amount of information they maintain regarding either depth or direction of a remembered target in 3D space.

Acknowledgements: We acknowledge the support of the NSERC and CIHR

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1474

Visual Working Memory Organizes Functional Related Objects beyond the Spatiotemporal Limit

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Ziyi Duan[1] (duanzy@mail2.sysu.edu.cn), Xuchen Song[2], Rende Shui[2], Jifan Zhou[2], Mowei Shen[2], Xiaowei Ding[1]; [1]Department of Psychology, Sun Yat-Sen University, Guangzhou, People’s Republic of China, [2]Department of Psychology and Behavioral Sciences, Zhejiang University, Hangzhou, People’s Republic of China

Functional relations can be directly “seen” and used to organize perceptual representations, but interactive positions are prerequisites for such perceptual grouping. The current study examined whether visual working memory (VWM) could automatically take advantage of functional relations in a more flexible way. In three experiments, participants were required to memorize a set of objects while ignoring the underlying relations between them. Results showed that although functional grouping was task-irrelevant, functional relations between objects could be extracted and used to enhance memory performance. More interestingly, functionally related objects could be grouped in the working memory phase even when they were not spatial interactive (Experiment 2). It was different from the perceptual grouping effect (Experiment 1) and reveals a unique memory grouping mode. Moreover, such functional grouping could still happen when object pairs entered VWM sequentially (Experiment 3), suggesting an active modification according to functional relations inside VWM. These findings suggest that VWM representations can be automatically structured through functional grouping, and grouping takes place in a flexible manner that can break the spatiotemporal constraints of perception.

Acknowledgements: 1. Humanities and Social Sciences Foundation of the Ministry of Education of China (19YJA190004). 2. Fundamental Research Funds for Colleges and Universities-Key Training Program for Young Teachers(19wkzd23).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
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23 June, 6:00 pm EDT America/New_York

Presenter's Message

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Abstract ID: 172

Visual working memory representations reflect the identity of prospectively-relevant visual stimuli

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

David De Vito[1] (ddevito@fsu.edu), Jacob A. Miller[2], Derek E. Nee[1]; [1]Florida State University, [2]University of California, Berkeley

Most working memory research focuses on our representations of the past. However, the utility of working memory lies in how it helps us prepare for the future. Despite this, little research examines representations that guide future cognition. Here, we examined neural representations of the past versus future in working memory. Participants followed a five-location sequence on the left and right side of the screen while being scanned with fMRI. On each trial, a cue pointed to the side that would be tested by an upcoming memory probe. After a delay, the probe tested for the identity of the stimulus that followed the previously presented item in the cued side's sequence. We submitted the average activations for each time point to a multiple regression analysis to investigate the role of visual and parietal areas in memory for the past versus the future. Activation in visual cortex and intraparietal sulcus transitioned away from representing the presented probe (the past) by the onset of the cue, demonstrating a period of "activity-silence." Following cue onset, we found ramping evidence for representation of the next item in the sequence (the future). Follow-up analyses indicated this future representation was part of a more general representation reflecting the probability of future stimuli. Hence, working memory appears to encode our expectations for the future. We argue that the retrospective codes commonly observed in working memory paradigms may be a reflection of the expectation of a test stimulus that matches the past. These findings begin to make clear that working memory is indeed "working" prospectively to guide thoughts and actions.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1553

Visual working memory samples sensory memory to enhance recall fidelity

Poster Presentation - *Topic area: Visual Memory: Capacity, representation*

Ivan Tomic[1] (it295@cam.ac.uk), Sebastian Schneegans[1], Paul Bays[1]; [1]University of Cambridge

Immediately after visual stimuli disappear from sight, representations of the vanished objects are thought to briefly persist in the sensory system with perceptual-level fidelity. This lingering trace of the most recent perceptual experience has been termed sensory, or iconic, memory and described as a virtually unlimited capacity store that deteriorates over a fraction of a second. Beyond this, recall relies on visual working memory (VWM) which is considered a strongly limited resource, but one which is stabilized against interference and temporal decay. Here, we systematically investigated the temporal dynamics of resource distribution and the deterioration of memory fidelity over very short intervals (0 – 1000ms). Participants viewed a set of randomly oriented stimuli and reported one of them based on a non-masking cue presented at variable delays relative to the offset of the stimuli. The target orientation was reproduced with a finger swipe on a touchpad, minimizing the opportunity for memory deterioration after the cue and providing a precise measure of response time. Contrary to previous assumptions, a robust set-size effect was observed from the moment of stimulus offset. This was followed by a rapid and then more gradual decrease of retrieval precision as the delay between stimulus and cue increased. These results were quantitatively captured by a model in which VWM fidelity is limited before the cue due to normalization of neural signal over multiple stimulus representations, but supplemented following the cue by residual activity from the sensory system. This leads to enhanced recall at the briefest delays while still being contingent on the number of stored objects. The more gradual deterioration over longer time-scales was accounted for by accumulation of random error in encoded feature values, as in previous work. These results extend a successful neurocomputational account of VWM to capture the first moments after a stimulus disappears.

Acknowledgements: This work was supported by the Wellcome Trust.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
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23 June, 3:00 pm EDT America/New_York
24 June, 4:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 680

Visual Memory: Contents, strategies

Contralateral delay activity, but not alpha lateralization, reflects effective gating in visual working memory

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Svea CY Schroeder[1,2], David Aagten-Murphy[3], Niko A Busch[1,2]; [1]University of Muenster, [2]Otto Creutzfeldt Center for Cognitive and Behavioral Neuroscience, Muenster, Germany, [3]University of Cambridge

Visual working memory (VWM) is inherently limited, making it important to select and maintain relevant information and to protect it from distraction by suppressing irrelevant, distracting information. Previous work has suggested the contralateral delay activity (CDA) and lateralized alpha oscillations (8–14 Hz) as neural candidates of such a gating process. While most of this work has focused on distraction during encoding, we investigated the effect of distraction during the maintenance interval. Participants (n = 30) encoded three lateralized targets in VWM and maintained these targets over a 3 sec delay. Half-way through the delay, distractors appeared briefly at the same location as the targets or in the opposite hemifield. Behavioral performance was most impaired by same-side distractors, less impaired by opposite-side distractors, and least impaired by weak, non-lateralized control distractors. In the pre-distraction interval, larger CDA amplitudes generally reflected better performance irrespective of the type of upcoming distraction. However, in the post-distraction interval and specifically after same-side distractors, larger CDA amplitudes were associated with stronger performance impairment, reflecting the disruptive influence of the distractor. Conversely, after opposite-side distractors, larger CDA amplitudes were associated with better performance, indicating a stronger focus on the target location. By contrast, alpha lateralization was determined only by the location of the distractor, irrespective of the targets' location. Importantly, we found no association between alpha lateralization and mnemonic performance. Our findings suggest that the CDA indexes not only the maintenance of recently encoded targets, but also the effective gating of distraction during maintenance. By contrast, alpha lateralization only indexes the current focus of spatial attention with no role in VWM-related gating.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
21 June, 3:00 pm EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1281

Decision strategy matters: Different testing procedures can change decision strategies and lead to spurious effects on estimates of visual working memory sensitivity

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Maria Robinson[1] (mrobinson@ucsd.edu), John Wixted[1], Timothy Brady[1]; [1]University of California, San Diego

Traditional theories of visual working memory (VWM) characterize it as a durable short-term memory store. This mainstream view has been challenged by results of Makovski and colleagues (2010), who reported that performance was impaired on 2-alternative-forced-choice (2-AFC) relative to single-probe change detection (CD) tasks. Makovski et al. (2010) proposed that the need to evaluate two stimuli in the 2-AFC testing procedure increases interference costs, which suggests that VWM representations may be more fragile than previously thought. Recent work replicated this difference in performance between 2-AFC and CD procedures (Schurgin, Wixted, & Brady, 2018). However, it is difficult to infer memory costs without first entertaining the range of decision strategies that people might employ under different testing conditions. We consider an alternative explanation for the purported cost in performance found in the 2-AFC task, which is grounded on the recall-to-reject strategy documented in the long-term memory literature (Rotello, Macmillan, & Van Tassel, 2000). According to this view, people treat the CD procedure as a source memory test, which allows them to use a process-of-elimination type strategy, e.g., when presented with a green probe, rather than simply judging how familiar green is, they use their entire set of knowledge: if they are very sure the item was red, they know it was not green. We show that such a strategy can lead to overestimates of sensitivity in CD tasks. Furthermore, this decision strategy would lead to symmetric receiver operating characteristic curves, even if underlying noise and signal distributions are unequal in variance. As such, this view also provides insight into why modeling results reveal consistent evidence for equal variance signal detection models in CD tasks (Schurgin, et al., 2019; Robinson, Irwin, & Benjamin, 2019), even when one might expect effects of item variability on memory.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Thanks for viewing the poster. This is work in progress, so feedback or suggestions is especially welcome. Please feel free to contact me at mrobinson@ucsd.edu.

Abstract ID: 611

Developmental changes in retrospective attention influence visual working memory precision

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Andria Shimi[1] (shimi.andria@ucy.ac.cy), Gaia Scerif[2]; [1]University of Cyprus, [2]University of Oxford

Visual working memory (VWM) improves dramatically during childhood but what drives this improvement is not well understood. One influential account thus far has been a simple increase in storage capacity (Cowan et al., 2010). However, recent findings have shown that differences in the ability to use attention retrospectively to enhance the maintenance of internal representations are also important for understanding developmental improvements in VWM (Shimi, Nobre, Astle, & Scerif, 2014). Yet, changes in this ability are not the endpoint to understanding developmental differences in VWM performance (Shimi & Scerif, 2017). Indeed, additional findings have indicated developmental changes in VWM precision (Burnett Heyes, Zokaei, van der Staaij, Bays, & Husain, 2012). In this study, we aimed to examine whether the developing ability to orient attention retrospectively to internal representations influences VWM precision differentially for children than for adults. To do so, we employed a paradigm that combined the continuous-recall VWM task with the partial-cueing report task. Specifically, seven-year-olds and young adults were asked to reproduce the colour of a probe item in a colour-wheel. The initial memory array, which included the probe item, could be uncued or followed by a spatial cue (retrocue) that directed participants' attention to a location in the memory array. Results showed that attentional biases engendered by retro-cues facilitated fidelity (overall precision) compared to uncued, baseline performance, for both age groups, but to a smaller degree in 7-year-olds compared to adults. Importantly, investigation of modelling parameters suggested that children demonstrate lower representational fidelity of items in VWM and that spatial attentional cues improve overall precision by increasing the probability of target storage, maintenance and recall, and by reducing misbinding errors as well as random guessing. These results extend further our knowledge on the relation between retrospective attention and VWM development.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 982

Dissociating the causal roles of V1, intraparietal sulcus, and dorsolateral prefrontal cortex in visual working memory

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Chenhao Hu[1] (714480916@qq.com), Kun Dong[2], Wenxuan Cheng[3], Han Wu[4], Tomok Kishimoto[4], Haojiang Ying[5], Fei Wang[1], Ru-Yuan Zhang[6]; [1]Tsinghua University, Beijing, China, [2]Radboud University, Nijmegen, the Netherlands, [3]Nanyang Technological University, Singapore, [4]Nankai University. Tianjin, China, [5]Soochow University, Suzhou, China, [6]University of Minnesota at Twin Cities

A large body of neuroimaging and brain stimulation studies have investigated the neural mechanisms of visual working memory (VWM). However, existing results are highly controversial. In particular, the causal links between regional activity and cortical computation are yet to be fully established. In this study, we combined computational modeling and continuous theta burst repetitive transcranial magnetic stimulation (rTMS) to investigate the causal contributions of V1, intraparietal sulcus (IPS), and dorsolateral prefrontal cortex (DLPFC) in the classical delay-estimation VWM task. 20 subjects completed the study in four days each for one of four experimental conditions (V1/IPS/DLPFC/sham) with at least a 48-hour interval between two real rTMS sessions. On each day, we delivered 600 stimulation pulses over the region-of-interest of that day before a subject performed the task. During the task, the subject was required to memorize a set of color squares (set size 2/4/6) for a short period (1000ms), and then choose the color of a cued square on a colorwheel. Most importantly, we fitted and compared seven mainstream models of VWM to uncover the computational underpinnings of perceptual consequences induced by rTMS. We found that rTMS over V1, compared with the sham condition, impaired the behavioral performance at set size 2 but not higher set size levels. rTMS over IPS and DLPFC had no significant effects on VWM performance. Computational modeling revealed that the variable precision (VP) (Van den Berg et al., 2012) model was the best-fitting model in all four conditions, suggesting that rTMS did not qualitatively change the computational strategy underlying VWM. However, according to the VP model, rTMS over V1 significantly reduced the amount of VWM resources at low set size levels. Taken together, our results support the sensory account of VWM and highlight the causal role of V1 in controlling the amount of VWM resources.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 924

Evidence of center-surround inhibition in visual working memory representation

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Zeyu Li[1] (zeyulee@163.com), Hanxi Pan[1], Xuanyi Wang[1], Songyan Lv[1], Zhi Li[1]; [1]Zhejiang University

Inter-item interference between working memory representations affects performance of working memory tasks. A traditional view suggests that the strength of interference may be proportional to the similarity between memory items. In contrast, according to a center-surround inhibition model, the strength of interference may rely on whether the memory representations fall into each other's inhibition zone. Consistent with the center-surround inhibition account, Fidalgo et al. (2017) found that the memory representation of color was less precise if it was interfered by color representations with intermediate similarity as compared to if it was interfered by highly similar or highly dissimilar color representations. However, their results could be an artifact of swap error. When the nontarget distribution is intermediately overlapped with target distribution, the swap errors may produce an effect as if the precision of memory representation decreases. To examine this alternative account, in the present study, we replicated Fidalgo et al.'s findings with a continuous report paradigm and analyzed the data with a mixture model that takes swap errors into account. The results showed that after the effect of swap errors was controlled, the recall precision of intermediately similar colors was still worse than that of highly similar or highly dissimilar colors. In addition, the representations of the two highly similar colors (or of the two intermediately similar colors, but not of the two highly dissimilar colors) were biased away from each other. This repelling effect further suggested the center-surround inhibition in working memory representation may exaggerate the difference between two memory representations so that they could be better retrieved later. The present results provided further evidence of center-surround inhibition in visual working memory representation, supporting Fidalgo et al. (2017).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 475

Eye tracking reveals two components of monitoring in prospective memory

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Seth, R. Koslov[1] (koslov@utexas.edu), Landry, S. Bulls[1], Jarrod, A. Lewis-Peacock[1]; [1]University of Texas at Austin

Prospective memory (PM) describes the ability to remember to perform goal-relevant actions at an appropriate time in the future despite other concurrent demands. Previous research posits a critical role for strategic, effortful monitoring of the environment for PM-related cues in successful PM task performance. The common method for inferring strategic monitoring in PM tasks is to compare response time slowing on an ongoing task performed with versus without a concurrent PM task, referred to as PM costs. However, the use of this indirect measure as a proxy for strategic monitoring has led to a debate as to how costs and subsequent PM performance are related to strategic monitoring. In the current experiment, participants performed an ongoing visual search task that varied in difficulty level while concurrently performing a PM-task that involved identifying the occurrences of face or scene targets presented elsewhere on the screen. We collected eye-tracking data in order to quantify monitoring for PM-targets, which we then related to both PM costs and PM performance. We found that PM costs were comprised of two distinct components: an overt monitoring component related to strategic evaluation of PM-target lures, and a covert monitoring component involving changes in gaze on the ongoing task. While both components were related to PM costs, the relative contribution of overt and covert monitoring was modulated by ongoing task demands ($t=9.11$, $p<.001$). Additionally, we found that accounting for both monitoring components explained the most variance in PM performance, as opposed to relying on overt monitoring alone (Wilcoxon pseudo-median = 0.289, $p<.001$). These results further specify multiple components of PM costs, and indicate that the relationship between costs and performance depends on the relative contribution of overt and covert monitoring processes. Future experiments would benefit from eye-tracking to more specifically explain the role of monitoring in PM.

Acknowledgements: R01 EY028746, UT Austin Provost Graduate Fellowship

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 6:00 pm EDT America/New_York

Presenter's Message

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Abstract ID: 935

Grouping and segregation in visual working memory

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Cheng Qiu[1] (qiucheng1019@gmail.com), Alan A. Stocker[1]; [1]University of Pennsylvania

Feature information can be distorted in visual working memory leading to characteristic biases in memory recall. Both repulsive and attractive biases have been reported, but a normative framework that reconciles these two distinct effects has been missing. Here, we introduce a framework that employs grouping and segregation as two fundamental processes necessary to create an efficient and robust memory representation of visual information. In its simplest form applied to the memorization of individual items, the framework creates memory representations that include not only sensory information but also discrete structural information about both the items' similarity (grouping) and their distinct identities (segregation). Memory retrieval consists of an active inference process that infers the original feature values from both the memorized sensory samples and structural information. We conducted a psychophysical experiment to test the basic predictions of our framework. Subjects (N = 8) were instructed to recall the angular positions of two briefly displayed dots. The angular distances between the dots were parametrically varied in a range from 6 to 60 degrees. We found that subjects' recalls were systematically biased depending on the distance between the dots. Recalled dot distances showed a transition from being over-estimated (repulsion) for small and under-estimated (attraction) for larger actual dot distances. This bias pattern is consistent with previous results measured for color (Colomb, 2015) or orientation features (Bae and Luck, 2017). Our framework predicts this general bias pattern and also accounts for the variance and correlation structure observed in our experimental data. The proposed framework can be expanded to model hierarchical memory representations where grouping and segregation act at different scales, and thus generalizes to richer stimulus patterns.

Acknowledgements: NSF grant IIS-1912232

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 932

How the content of visual working memory regulates the priority for access to visual awareness for memoranda with multiple features

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Yun Ding[1] (y.ding1@uu.nl), Marnix Naber[1], Chris Paffen[1], Stefan Van der Stigchel[1]; [1]Utrecht University

Previous studies suggest that storing an item in visual working memory (VWM) prioritizes access to visual awareness for this item. It is currently unclear 1) which features of memoranda affect the priority to access visual awareness and 2) how these features interact. To explore this, we conducted a series of experiments in which we intermixed a delayed match to sample memory task to manipulate VWM content and a breaking Continuous Flash Suppression (b-CFS) task to measure prioritization for visual awareness. In the experiments, observers were required to memorize either the color (Expt. 1), the color and shape (Expt. 2) or the shape (Expt. 3) of an item for the memory task. In the CFS period, observers had to indicate the location of a suppressed target which could match the memorized item in color, shape, both color and shape, or none of the features. Our results show that color-matching but not shape-matching targets broke suppression faster when only the color (Expt. 1) or both color and shape (Expt. 2) were to be remembered. When only shape but not color was relevant for the memory task (Expt. 3), color still largely drove the shortening of suppression duration of the target, with a minor influence of shape. Interestingly, a target that matched one feature of the memory probe (either the color or shape) in Expt. 3, was released from suppression faster than a target matching neither the color or the shape. Our results imply that: 1) VWM affects the priority for different features to a variable degree; 2) color dominates prioritization; 3) Even irrelevant (incidental) features can be prioritized.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 783

Individual items in visual working memory inherit ensemble properties

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Igor Utochkin[1] (isutochkin@inbox.ru), Timothy Brady[2]; [1]National Research University Higher School of Economics, Russia, [2]University of California San Diego

Prevailing theories of visual working memory assume that each encoded item is stored or forgotten as a separate unit independent from other items. Here, we show that items are not independent, and that the recalled orientation of an individual item is strongly influenced by the summary statistical representation of all items (ensemble representation). In Experiment 1, we briefly shown our participants a set of four triangles of various orientations and asked them to remember an orientation of (1) a single triangle, (2) all four individual triangles, or (3) the mean orientation of the four triangles. The orientations were distributed with equal steps along a range of 30, 60, and 120 degrees. When observers remembered one orientation, their memories had always the same precision regardless of range and were mostly unbiased. However, when observers had to remember all four orientations, not only was memory for an individual orientation substantially biased towards the mean orientation, but the precision of memory for an individual item also closely tracked the precision with which people stored the mean orientation (which was, in turn, correlated with the physical range of orientations). Thus, individual items are reported more precisely when items on a trial are more similar. Moreover, the narrower the range of orientations present on a trial, the more participants appear to rely on the mean orientation as representative of all individuals. This pattern was replicated when we discouraged observers from explicit encoding of the mean (Experiment 2). This ensemble influence can also be observed not only when the range is carefully controlled, but also shown even in randomly generated, unstructured displays (Experiment 3). Our results suggest that the information about a set of items is represented hierarchically, and that ensemble information can be an important source of information to constrain uncertain information about individuals.

Acknowledgements: Experiments 1 and 2 were supported by Russian Science Foundation grant 18-18-00334 to I.S.U. Experiment 3 was supported by NSF CAREER grant BCS-1653457 to T.F.B.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 476

Interactions between the ‘visuospatial sketchpad’ and the ‘phonological loop’: task-irrelevant spatial structure benefits working memory, in spite of explicit rehearsal

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Sami Yousif[1] (sami.yousif@yale.edu), Frank Keil[1]; [1]Yale University

Working memory is commonly understood as consisting of two distinct sub-systems: a ‘visuospatial sketchpad’ and a ‘phonological loop’. Studies of visual working memory often deliberately ignore the

phonological loop, using stimuli that cannot be easily verbally encoded (e.g., oriented lines). But how do these two seemingly distinct systems interact? Here, we ask whether (and how) task-irrelevant spatial structure influences working memory. Observers were introduced to a novel working memory task in which they saw a series of 5-7 shapes that appeared (a) in one of four colors and (b) in one of four locations (quadrants). They were explicitly told that they had to recall only (a) the shapes that they saw and (b) the order they saw them in — not color or location. On some trials, space was structured so that any shape appearing multiple times appeared in the same location and no other shape appeared in that location (whilst color was randomized); on other trials, color was structured (whilst location was randomized). This task therefore had two key components: (1) both color and location information were task-irrelevant; (2) the to-be-remembered information (shape names) could be rehearsed. Despite this (and frequent participant reports of a rehearsal strategy), we observed a robust memory advantage in the space-structured condition. We replicate this general pattern across several experiments, and further show that these findings (a) should be understood as a space-advantage rather than a color-decrement, and (b) this benefit occurs because of the consistency for location within object (rather than the lack of overlap between objects). In other words, it appears that spatial information (ostensibly invoking the 'visuospatial sketchpad') benefits working memory, even when observers explicitly use a rehearsal strategy — suggesting a prioritization of spatial information. These findings also address how task-irrelevant spatial information influences working memory in the first place.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 309

Mechanisms of attentional priority in Working Memory are context-dependent

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Asal Nouri[1,2,4] (anouri2015@fau.edu), Edward Ester[1,2,3,4]; [1]Florida Atlantic University, [2]Center for Complex Systems and Brain Sciences, [3]Department of Psychology, [4]FAU Brain Institute

Working memory (WM) performance can be enhanced by an informative cue presented during storage. This effect – termed a retrocue benefit – can be used to explore how participants prioritize information stored in memory for behavioral output. Previous research has shown that retrospective cues directing participants to prioritize a subset of items stored in memory (i.e., directed-remembering cues) and cues

directing participants to ignore a subset of items stored in memory (i.e., directed-forgetting cues) confer similar benefits on WM performance, but it is unclear whether these cues engage similar selection mechanisms in WM. We tested this possibility by examining how directed-remembering and directed-forgetting retrocues influenced location-specific working memory representations reconstructed from human EEG activity. We recorded EEG while participants performed a retrospectively cued spatial working memory task requiring the maintenance of two locations over a short delay. During cued trials, a fully informative retrospective cue presented midway through the memory delay directed participants to prioritize (50% of valid trials) or ignore (remaining 50% of valid trials) one of the locations stored in memory. Consistent with earlier findings, directed-remembering and directed-forgetting cues both improved memory performance relative to no-cue trials, though the magnitude of this benefit was significantly greater for directed-remembering cues. Next, we examined the effects of directed-remembering and directed-forgetting cues on location-specific working memory representations reconstructed from concurrent EEG recordings. During no-cue trials, the fidelity of location-specific WM representations gradually decreased over the course of the delay period. Directed-remembering and directed-forgetting cues partially reversed this information loss, though the degree of recovery following these cues were substantially lower than the degree of recovery seen after a directed-remembering cue. Thus, directed-remembering and directed-forgetting cues appear to engage similar selection mechanisms within WM, but directed-remembering cues confer larger benefits on WM performance.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1342

Multivariate EEG evidence for feature-independent storage in visual working memory

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

William Thyer[1] (thyer@uchicago.edu), Kirsten Adam[2], Edward Vogel[1], Edward Awh[1]; [1]University of Chicago, [2]University of California, San Diego

Discrete resource models of visual working memory (WM) suggest that the “currency” of WM is best understood in terms of items rather than in terms of the number of independent features that are stored. For instance, it is possible that WM storage is limited by a “pointer system” that can select a maximum number of individuated representations, without regard to the specific features that are maintained, or the

total number of features associated with each item. Here, we show that ongoing EEG activity, analyzed via multivariate classification of voltage topography, provides positive evidence for feature-independent storage in visual WM. Using visual displays that controlled for the total amount of sensory stimulation, we manipulated the number of items stored in visual WM (1-4), while varying the feature content of the memoranda. A common group of subjects participated in 3 separate EEG sessions, during which memoranda varied between colors, orientations, and colored oriented lines. Using logistic regression, we observed robust decoding of the number of targets in the test display for each type of stimulus, even at the single-trial level. Critically, cross-training analyses showed that a multivariate model trained on one feature (e.g., color) could effectively decode the load for a different feature (e.g., orientation) as well as for conjunction stimuli that contained double the number of relevant features. In the latter case, a single item with one relevant feature (e.g., color or orientation) yielded the same load signature as an item with double the feature load (color and orientation), indicating that this multivariate index of WM load is independent of the total number of features stored. These findings highlight a time-resolved method for tracking storage loads in visual WM, while providing positive evidence for a feature-independent aspect of storage that may underlie item limits in visual working memory.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1255

Stimulus generalizability of performance feedback training on metacognitive accuracy of visual working memory

Poster Presentation - *Topic area: Visual Memory: Contents, strategies*

Caitlin Tozios[1], Anjali Pandey[2], Keisuke Fukuda[1,3]; [1]University of Toronto, [2]Dalhousie University, [3]University of Toronto Mississauga

In any moment, the quality and the quantity of information represented in visual working memory (VWM) is severely limited. Additionally, individuals tend to overestimate the accuracy of representations held in VWM, leading to confident-but-inaccurate responses (e.g., Adam & Vogel, 2017). Since it is difficult to improve the capacity of VWM, we instead aimed to improve the accuracy of metacognitive assessments of VWM representations. In the first experiment, participants remembered an array of simple objects (e.g., coloured squares or oriented lines) over a one second retention interval. Using a whole-report method

(e.g., Adam & Vogel, 2016), participants then reported the colour or orientation of each object along with the confidence of their report. Importantly, performance feedback was given for each response to promote confident-and-accurate responses while discouraging confident-but-inaccurate responses. More precisely, confident-and-accurate responses led to larger reward points than not-so-confident-but-accurate responses, while confident-but-inaccurate responses resulted in larger penalty points than not-so-confident-and-inaccurate responses. Results demonstrated that in both younger and older adults, our feedback improved metacognitive accuracy for VWM representations, leading to a significant reduction of confident-but-inaccurate responses. Furthermore, this improvement was observed even after the performance feedback was removed. Interestingly, this training effect was more immediate and larger in magnitude when compared to a control experiment without feedback (Experiment 2). In Experiment 3, the training effect was found to generalize to an untrained stimulus. That is, when participants were given feedback training on one type of stimulus (e.g., colour) and then tested on the untrained stimulus (e.g., oriented lines), their metacognitive accuracy for the untrained stimulus was higher than before training. Therefore, we demonstrate that not only does feedback training improve metacognitive accuracy, but this training effect also generalizes to an untrained stimulus.

Acknowledgements: This work was supported by an NSERC Discovery Grant (RGPIN-2017-06866) and the Connaught New Researcher Award awarded to KF

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 949

Visual Memory: Encoding, representations, search

Alpha-band activity selectively tracks targets but not distractors following spatial cues.

Talk Presentation - *Topic area: Visual Memory: Encoding, representations, search*

David Sutterer[1], Geoffrey Woodman[1]; [1]Vanderbilt University

Recent work finds that the location of remembered stimuli can be reconstructed from patterns of EEG alpha-band activity (Foster, Sutterer, Serences, Vogel, & Awh, 2016) and that online spatial representations are maintained even when the location of stimuli are task irrelevant (Foster, Bsales, Jaffe, & Awh, 2017). Interestingly, power increases in this same frequency band of activity (8 – 12 Hz) have been hypothesized to reflect the filtering of irrelevant visual input (Jensen & Mazaheri, 2010), and a well-known characteristic of alpha-band activity is that power decreases contralateral to a cued hemifield and increases ipsilateral to the un-cued hemifield. Previous work reconstructing the location of remembered stimuli has always relied on stimuli presented across hemifields. Thus, an open question is whether alpha-band activity spontaneously tracks the location of distractors presented in an irrelevant hemifield or if a spatial pre-cue is sufficient to allow filtering of distractors. To answer this question, we used a lateralized spatial estimation task. On each trial, observers were centrally cued to remember the location of dots (1 or 2) presented to the left or right of fixation while ignoring the location of distractor dots presented on the un-cued side of the screen. Dots in both hemifields were presented on a circle (radius of 4 degrees of visual angle) that was centered 6 degrees of visual angle from fixation. By applying an inverted encoding model (IEM) to the topography of alpha-band activity on the scalp, we found that we were able to successfully estimate remembered locations for target items on both one- and two-item trials. Critically, we were unable to reconstruct the location of distractor items. Together these results suggest that alpha-band activity tracks the location of targets but not distractors and that spatial cues are an effective means of filtering distractors.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

Thanks for attending my v-vss talk. Please feel free to contact me with questions and suggestions.

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twitter: https://twitter.com/sutterer

Abstract ID: 1228

Attentional deployment during visual search predicts subsequent long-term memory of real world objects

Talk Presentation - *Topic area: Visual Memory: Encoding, representations, search*

Mark E. Lavelle[1] (mark.lavelle@utah.edu), Kobe Cornelison[1], Lauren H. Williams[1], Trafton Drew[1];
[1]University of Utah

Prior research suggests that repetition-related learning effects during repeated target visual search are sustained after delays (Servant, Cassey, Woodman & Logan, 2018). However, the extent to which participants subsequently remember repeatedly encountered targets is currently unclear. Moreover, little is known about whether EEG activity accompanying repeated encoding processes predict subsequent memory for those objects. We recorded EEG in response to a lateralized target cue while participants (N=20) searched six times consecutively for one of 198 unique real world target objects. Following the search task, we tested their recognition memory for those targets by asking them to select the object they had seen before in an array of 9 objects. We replicate the following findings related to the repetition of targets: 1) reduced reaction time and increased accuracy of visual search; 2) reduced working memory representation of targets indexed by smaller CDA amplitudes; 3) enhanced attentional deployment to targets indexed by larger N2pc amplitudes, and; 4) greater familiarity for targets indexed by reduced FN400 amplitudes. Despite robust repetition-related effects suggestive of learning, nearly 40% of targets were subsequently forgotten. The following behavioral and neurophysiological measures during encoding predicted subsequent memory for a given object: 1) faster and more accurate responses during visual search; 2) greater N2pc amplitude after the first repetition, and; 3) reduced FN400 amplitude after the first repetition. We did not observe a reliable effect due to subsequent memory on CDA amplitudes. These results suggest the likelihood of a target being remembered corresponds with the deployment of visual attention and the degree of familiarity it generates, but not working memory resources. In sum, repetition effects overlap with processes that facilitate successful encoding and recognition of images. Future research should clarify what role repetition-related working memory disengagement serves in encoding of images.

Acknowledgements: This work was supported by the Binational Science Foundation Grant # 2018106 to TD and RL.

This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 295

Cross-fixation interactions of orientations suggest that orientation decoding occurs in a high-level area of visual working memory

Talk Presentation - *Topic area: Visual Memory: Encoding, representations, search*

Long Luu[1] (thelong20.4@gmail.com), Mingsha Zhang[2], Misha Tsodyks[3], Ning Qian[1]; [1]Columbia University, [2]Beijing Normal University, [3]Weizmann Institute of Science

Visual encoding (how stimuli evoke neuronal responses) is known to progress from low to high levels. Decoding (how responses lead to perception), in contrast, is less understood but is widely assumed to follow the same, low-to-high-level hierarchy. According to this assumption, orientation decoding must occur in low-level areas such as V1, and consequently, two orientations on opposite sides of the fixation should not interact with each other perceptually. However, Ding et al (PNAS, 2017) provided evidence against the assumption and proposed that visual decoding may follow the opposite, high-to-low-level hierarchy in working memory. If two orientations on opposite sides of the fixation are both task relevant and enter a high-level working-memory area in a delay period, then they should interact with each other. We tested this prediction. Subjects maintained central fixation when two lines with an orientation difference of 5° were flashed on opposite sides of the fixation, with a center-to-center distance of 16° of visual angle. Their eye positions were monitored with an infrared eye tracker and trials with broken fixation were aborted. After a delay, subjects reported the two orientations by drawing and adjusting an indicator line at the fixation. In one condition, the indicator line disappeared after the first report, and was redrawn for the second report, to minimize potential interference. We found that the two lines showed a large and significant repulsion between them, demonstrating the predicted cross-fixation interactions in working memory. The pattern was consistent across 14 subjects. Control conditions and analyses ruled out alternative explanations such as interactions across trials on the same side of the fixation. Moreover, we quantitatively accounted for the repulsion with the retrospective Bayesian decoding model in Ding et al. We conclude that our results support the theory that visual perception may be viewed as high-to-low-level decoding in working memory.

Acknowledgements: Funding grants AFOSR FA9550-15-1-0439 and NSF 1754211

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 216

The influence of stimulus uncertainty on attractive and repulsive perceptual biases

Talk Presentation - *Topic area: Visual Memory: Encoding, representations, search*

Sabrina Hansmann-Roth[1], Árni Kristjánsson[1,2], Andrey Chetverikov[3,4]; [1]Icelandic Vision Lab, University of Iceland, [2]School of Psychology, National Research University Higher School of Economics, Moscow, Russia, [3]Donders Institute for Brain, Cognition, and Behavior, Radboud University, [4]Cognitive Research Lab, Russian Academy of National Economy and Public Administration, Moscow, Russia

Our visual environment is relatively stable from one moment to the next. Even if the current visual input is noisy, it is generally likely to be similar to the previous input. Incorporating prior and present information is therefore advantageous. Studies of serial dependence reveal attractive biases towards previously attended stimuli that stabilize noisy visual input, but their strength scales with the uncertainty in the stimulus: With greater uncertainty comes greater serial dependence. More recent work shows that ignored visual information in the scene creates repulsive biases that can also serve to optimize perception. Here, we investigate the role of uncertainty on both types of bias. In previous studies, attractive biases have been found to scale with uncertainty through manipulation of the sensory noise in the stimulus, but two questions remain unanswered: Firstly, how does integration noise (here distractors) influence the attractive bias? Secondly, does the repulsive bias introduced by ignored information also scale with uncertainty? We designed two experiments in which either sensory noise (contrast) or integration noise (orientation variability of distractors) was manipulated. This creates high and low uncertainty trials. For a set of 2 or 3 trials, observers searched for an oddly-oriented line and were subsequently asked to adjust a single line so that it matched the previous target. Uncertainty was either kept constant during search trials or changed on the last search trial. Afterwards observers were asked to judge their confidence about their adjustment response. Preliminary results show that not only sensory noise, but also integration noise, affected the strength of the attractive bias while these effects were not found for the repulsive bias. The repulsive bias therefore appears not to be influenced by uncertainty. Confidence judgments were reduced when uncertainty changed during search trials, independent of the type of noise.

Acknowledgements: SHR and AK were supported by grant IRF #173947-052 from the Icelandic Research Fund.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 142

True swap errors versus misbinding in visual short-term memory revealed using free full report

Talk Presentation - *Topic area: Visual Memory: Encoding, representations, search*

Younes Adam Tabi[1] (younes.tabi@ndcn.ox.ac.uk), Sanjay George Manohar[1], Masud Husain[1]; [1]University of Oxford

Recall errors from visual short-term memory are often not random. Rather, people may erroneously report information about the wrong item in memory. These have been interchangeably referred to as “swap errors” or “misbinding”. For true swap errors, features should be incorrectly bound two ways: for the probed item as well as for the “swapee” – the other item in memory whose features are being swapped. However, previous evidence argues against true swaps, because when two features of an object have to be reported, errors are uncorrelated. Here, we demonstrate that it is possible to distinguish two mechanisms for reporting features from the wrong item: true swaps and one-way misbinding. For one-way misbinding, only one object’s feature is swapped, whereas information about the other object’s feature might be lost, requiring participants to guess. Previous cued recall approaches cannot distinguish these two types of error. In our free full report design, participants remembered the colours and locations of three dots shown at random locations on an imaginary circle, in random colours from a colour wheel. In cued recall, participants were cued with each of the colours, and had to reproduce the corresponding locations, or vice versa. To test free full recall, they reported both features of each object. In either case, participants reported all items in the array in self-determined order. A new mixture model was able to account for true swap errors, as well as one-way misbinding. To do this, we introduced individual guessing parameters depending upon whether participants reported objects correctly or swapped. Furthermore, we distinguished between (i) guessing the whole object vs (ii) a feature, and between (a) guessing the swapped vs (b) non-swapped feature. Our findings show that what has previously been labelled as swap error can, in fact, be decomposed into true swap errors, or one-way misbinding.

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This talk will be presented in Live Talk Session 1, Friday, 19 June, 1:00 pm EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

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The presenter has not provided any messages for this presentation.

Abstract ID: 1772

Visible persistence speeds up visual search

Talk Presentation - *Topic area: Visual Memory: Encoding, representations, search*

Zhi Li[1] (zli1@zju.edu.cn), Keyun Xin[1]; [1]Department of psychology and behavioral sciences, Zhejiang University

Iconic memory has been considered as the very first storing stage in human visual system. While it is still not clear what role iconic memory plays in vision, two distinctive components of iconic memory, i.e., visible persistence (VP) and informational persistence (IP), have been identified. Visible persistence is relatively brief (150 ms) and is thought of as a pre-categorical visual representation of the physical stimuli. It appears that visible persistence would not have a real function in vision. However, in the present study, we had an astonishing discovery that visual search is more efficient when VP of the search display is available than when it is not. We found a clear turning point in the search time x set size function using a TSED (threshold stimulus exposure duration) paradigm (Li et al., 2019). The turning point showed up at set size 4 for letter stimuli but at set size 7 for color stimuli, suggesting that it is not due to the working memory capacity of remembered locations (which should predict a turning point at fixed set size irrespective of the content of search). For both letter and color, search time of the turning point was closely matched to the duration of visible persistence of the search array. Moreover, this turning point disappeared when the starting time of search was delayed so that VP of the search display was no longer available during search. The enhancement in search efficiency is not due to a faster individuation, because a turning point was found at set size 4 for both the letter and color stimuli in a subitizing paradigm. These findings suggest that visible persistence might support faster visual comparison that occurs in most visual tasks and thus reduces the burden of working memory.

Acknowledgements: This study was supported by a grant from the National Natural Science Foundation of China (31671129)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thank you for your interest in my talk. If you have comments or questions regarding the contents in this talk, please feel free to leave a message in the asynchronous Chat area, or email me at zli1@zju.edu.cn.

Zhi Li

Abstract ID: 483

Visual Memory: Individual differences

Enhanced object individuation and memorization in the elderly after working memory practice

Poster Presentation - *Topic area: Visual Memory: Individual differences*

Chiara Tagliabue[1] (chiara.tagliabue@unitn.it), Sara Assecondi[2], Giulia Cristoforetti[3,1], Veronica Mazza[1]; [1]Center for Mind/Brain Sciences (CIMeC), University of Trento, [2]Centre for Human Brain Health (CHBH), University of Birmingham, [3]University of Ghent

Aging is characterized by a decrease in visual working memory (vWM) capacity, which has recently prompted the development of various training interventions. The majority of the proposed interventions are long-term behavioral trainings, usually aiming at transferring gains to other untrained cognitive tasks/domains. Thus, whether short practice (i.e. simple task repetition over a brief period of time), could be as effective as the above mentioned trainings in boosting vWM has remained surprisingly little explored. Investigating short-practice effects is, indeed, a relatively simple and rapid way to evaluate whether a specific ability can be improved in the elderly. By combining behavioral and electrophysiological (EEG) indexes we investigated the effects of short-term vWM practice in young and older participants performing a vWM task over 4 consecutive days. Behavioral results indicated larger improvements in older participants, who increased in both sensitivity (d') and vWM capacity (k), and ultimately reduced the gap in vWM limit with the young counterparts. The behavioral outcomes were supported by practice effects observed in EEG responses. In both groups, attentive individuation (reflected by the N2pc) was modulated by target numerosity only after practice (in line with d' results). Moreover, in young participants, the Contralateral Delay Activity (CDA), a neural correlate of item maintenance in the WM buffer, indexed target numerosity across all sessions; in the elderly, the CDA was modulated by the different memory loads only after practice (in line with k values). The results indicate that practice acts through modifications at different levels of stimulus processing, and in turn suggest that the age-related WM decrease can be caused by different deficient mechanisms. Specifically, our data showed that practice can effectively improve vWM of older individuals by enhancing the selective individuation of the target elements, with a cascade effect on their memorization.

Acknowledgements: This work was supported by Fondazione Cassa di Risparmio di Trento e Rovereto (CARITRO).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 650

Longitudinal consistency of synesthetic colors for 300 graphemes

Poster Presentation - *Topic area: Visual Memory: Individual differences*

Kazuhiko Yokosawa[1] (yokosawa@l.u-tokyo.ac.jp), Kyuto Uno[1], Michiko Asano[2]; [1]The University of Tokyo, [2]Rikkyo University

Grapheme–color synesthesia is a condition in which a visual grapheme induces a specific color sensation. A defining characteristic of synesthesia is the temporal (test-retest) consistency of synesthetic associations across the lifespan. However, Simner et al. (2017) compared synesthetes from two age groups (below and above 35 years of age) and demonstrated that the consistency of synesthetic associations is lower in older synesthetes. Therefore, further investigations are warranted to determine the longitudinal trends and factors contributing to age-related changes in these associations. We examined longitudinal synesthetic color consistency over five to ten years for 300 graphemes (alphanumeric letters and Japanese characters) in eight grapheme-color synesthetes in their late 20s at the beginning of the study. The results indicated that the synesthetic color for almost none of the graphemes disappeared, although the long-term consistency was lower than the short-term consistency over approximately three weeks, as measured at the beginning and the end of the study period. However, the long-term consistency of all synesthetes met the consistency criterion of synesthesia (Rothen et al., 2013). The results also showed that graphemes with unstable synesthetic color responses over short periods were also unstable over long periods. Graphemes with both low short- and long-term consistencies tended to have low familiarity and high visual complexity. It has been suggested that synesthetic grapheme-color associations are shaped by grapheme learning (Asano et al., 2019), which might facilitate stronger grapheme-color associations with increased frequency of the graphemes occurring. The correlation between high visual complexity and color inconsistency might be related to the finding that multiple colors are likely to be associated with characters and words consisting of multiple elements (Mankin et al., 2016; Uno et al., 2019). In such cases, synesthetic color reports would become less stable if synesthetes are asked to select just one color for each grapheme.

Acknowledgements: This study was supported by JSPS KAKENHI Grant Number 19H01770.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 354

Tactile object recognition performance on graspable objects, but not texture-like objects, relates to visual object recognition ability

Poster Presentation - *Topic area: Visual Memory: Individual differences*

Jason Chow[1] (jason.k.chow@vanderbilt.edu), Thomas Palmeri[1], Isabel Gauthier[1]; [1]Vanderbilt University

Recent work suggests a domain-general visual object recognition (OR) ability that is relevant across different tasks and various object categories, both novel and familiar (Richler et al., 2019; Gauthier et al., VSS2020). This domain-general OR ability was found to be independent from general intelligence or working memory capacity but whether it is specific to visual processing or generalizes to object processing from touch is unknown. Tactile exploration of objects can extract features similar to those useful for visual OR like global shape and object texture using hand enclosure and lateral finger movements, respectively (Lederman and Klatzky, 1987). Here, we asked if tactile OR performance relates to visual OR ability. Participants performed two visual tasks with novel objects. In the Novel Object Memory Tasks (NOMT) participants memorized six exemplars of Ziggerins, then performed a three-alternate forced-choice recognition task (Richler, Wilmer, & Gauthier, 2017). In a Matching task, participants judged whether two Sheinbugs presented serially were the same or different. Participants also performed a tactile NOMT using finger-sized texture-like buttons mounted on cards and a Matching task with palm-sized graspable spaceships mounted on boards. We estimated general intelligence using Raven's matrices and partial out intelligence in our correlational analyses. Visual OR ability was estimated as the composite of the two visual OR tasks, which were correlated as expected (r_{49}=.34, BF10=3.68). In contrast, we found evidence supporting no relationship between the two tactile OR tasks (r_{49}=.03, BF10=.17). Interestingly, the tactile NOMT did not correlate with visual OR (r_{49}=.03, BF10=.17), while the tactile Matching task did (r_{49}=.34, BF10=3.66). These results suggest that domain general OR ability may not be a strictly visual ability but may also apply to tactile processing of graspable 3D shapes. Conversely, recognizing smaller objects with fingertips, more akin to 2D textures, could tap into a different ability.

Acknowledgements: This work was supported by the NSF (SMA-1640681).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 188

o is the same for familiar and novel objects

Poster Presentation - *Topic area: Visual Memory: Individual differences*

Isabel Gauthier[1] (isabel.gauthier@vanderbilt.edu), Mackenzie A. Sunday[1], Andrew J. Tomarken[1], Sun-Joo Cho[1]; [1]Vanderbilt University

Recent work (Richler et al., 2019) revealed a reliable domain-general object recognition ability, o, independent from general intelligence. o was originally measured only with novel objects to avoid the problem of variability in experience, but here we extend this work by measuring o for both novel and familiar objects. In addition, we measure performance for ensemble mean judgments, to characterize the extent to which ensemble processing relates across categories and is related to o. Prior work found strong correlations between ensemble coding of face identity and face expression (Haberman Brady & Alvarez, 2015) and between performance on ensemble judgments tasks with different non-face categories (Chang & Gauthier, VSS 2020), but the relation to o has not been investigated. Here, we collected data from 285 subjects using images of three categories of novel objects (Ziggerins, Sheinbugs and Greebles) and three categories of familiar objects (birds, planes, Transformers). For each category, subjects performed three tasks: a learning task (similar to the Novel Object Memory Test and the Vanderbilt Expertise Test), a matching task (same/different) and an ensemble mean judgment task for arrays of four items. We used Confirmatory Factor Analysis to estimate on for novel objects and of for familiar objects using indicators from the learning and matching tasks, as well as an ensemble perception factor. Results revealed that the model fit well (RMSEA= .038), with an almost perfect correlation between on and of (.985) and a strong correlation between the ensemble perception factor and on and of (.63 and .69, respectively). The results support a common domain-general ability across familiar and novel objects, despite the variability in experience that subjects have with familiar categories. They also support recent findings of a domain-general ability for ensemble processing, which shows a robust relation with o.

Acknowledgements: This work was supported by the NSF (SMA- 1640681)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 144

Visual Memory: Long term

Influence of outstanding object memories on gist representation in visual long-term memory

Poster Presentation - *Topic area: Visual Memory: Long term*

Maria Servetnik[1,2] (servetnikmaria@gmail.com), Igor Utochkin[2]; [1]KU Leuven, [2]National Research University Higher School of Economics

Recent evidence suggests that visual information in memory can be stored as a hierarchy of representations from feature to object to gist of many objects (Brady & Alvarez, 2011; Brady et al., 2011, 2018). Memory for individual objects' color is biased toward the gist in long-term memory, that is, mean color of a list of learned objects (Brady et al., 2018). Here we asked whether individual objects with outstanding features can affect the gist memory. Evidence from ensemble summary statistics suggests that salient or outstanding objects would either disproportionately influence the gist (Kanaya et al., 2018) or would be completely excluded from the gist (Haberman & Whitney, 2010). In our experiment, we compared color gist-based bias in long-term memory for categories with and without outliers using the continuous report paradigm (Wilken & Ma, 2004; Zhang & Luck, 2008). The experiment consisted of five identical blocks. In each block, participants were asked to memorize 40 images of real-world objects from four different categories, such as armchairs, scarves, or notebooks. Individual object colors for each category were generated from a normal distribution with a randomly chosen mean from a CIE Lab color wheel. In half of the categories across all blocks, one object was a color outlier: Its color was located fairly at "tails" of the categorical normal distribution. The participants were then tested with 2AFC for recognition memory with old and new exemplars from the same categories. The participants had to choose an old exemplar and report its color using a color wheel. Color reports were analyzed using the mixture models. Our results showed that individual memories were biased towards the categorical mean, with outliers excluded from the mean (gist) computation. This supports the Bayesian integration model as an adaptive mechanism in visual long-term memory (Brady, Schacter, & Alvarez, 2018).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 411

Is there an impact of low-level visual properties on long-term memory interferences?

Poster Presentation - *Topic area: Visual Memory: Long term*

Jean-Maxime Larouche[1] (jean-maxime.larouche@umontreal.ca), Valérie Daigneault[1], Clémentine Pagès[1], Philippe Laliberté[1], Frédéric Gosselin[1]; [1]University of Montreal

Several studies have shown that low-level perceptual similarity does not predict interferences in memory. These studies all used protocols that promote declarative learning by the medial temporal lobe. However, we know that low-level brain regions demonstrate neuronal plasticity resulting also from rewards conveyed by the striatum, which—unlike the medial temporal lobe—receives and sends information almost everywhere in the brain, including V1. Thus, the purpose of this study was to test whether low-level visual properties (spatial frequencies and orientations) influence interferences in memory by using a task that promotes response-stimuli association by the striatum. On day 1, two subject groups (N=45) learned to discriminate two sets of 12 target faces from 20 different non-target faces (with auditory feedbacks). The two target face sets were filtered by the same log-polar checkerboards in the Fourier domain in subject group 1 while they were filtered by different, non-overlapping log-polar checkerboards in subject group 2. To promote associations between low-level properties and response, the non-target faces were also filtered by another non-overlapping log-polar checkerboard; thus making low-level properties useful for solving the task. On day 2, subjects had to discriminate between three alternatives: target face set 1, target face set 2 and novel non-target faces. We compared interferences — confusions between target face set 1 and 2 — in subject group 1 and group 2. H0 predicts no differences between subject groups, whereas H1 predicts a greater number of interferences in subject group 1 than group 2 because the group 1 target face sets produce more similar activations in V1. Bayesian analyses indicate substantial evidence (Bf01 = 3.4) in favor of H0, thereby supporting the idea that low-level visual properties do not impact interferences in memory, even when learning is based on a response-stimuli association.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 837

Orienting attention in short-term and long-term memory across ageing

Poster Presentation - *Topic area: Visual Memory: Long term*

Oana Gurau[1] (oana.gurau@ndcn.ox.ac.uk), Dejan Draschkow[1], Thomas Graham[1], Nahid Zokaei[1], Anna C. Nobre[1]; [1]University of Oxford

Attention can be deployed to internal representations stored in memory. Typically, this is demonstrated using retrospective cues (retro-cues), which guide prioritisation and selection within the mnemonic content in short-term memory (STM). To investigate whether and how similar attention-orienting mechanisms may operate within long-term memory (LTM) we designed new tasks to compare the effects of retro-cues in STM and LTM and compared performance across ageing. In the STM task, observers had to remember the identities and locations of two objects presented on a scene. During the delay they were either presented with a neutral or spatially informative retro-cue. Observers were then probed by a choice of two objects and had to pick the object previously associated with the scene and then drag it to the remembered location. In the LTM task, observers first performed a search task in which they located two objects within a series of scenes, yielding novel object-scene associations. They later completed an explicit recall test, similar in structure as the STM task. A scene (without the objects) appeared, followed by a spatial or neutral retro-cue, and then a choice of two items. Participants selected the item associated with the scene in LTM and dragged it to its original position. Our results showed that both LTM and STM retrieval benefit from retro-cueing, improving both localization precision and response times in younger and older participants. Younger participants performed better for both conditions and tasks, but orienting benefits were equivalent. Furthermore, performance benefits of orienting attention for the precision of localizing objects based on STM and LTM were positively correlated across both age groups. Our findings suggest similarities in attention-orienting mechanisms for memories with different time spans and indicate that the ability to orient attention in memory is relatively preserved in ageing despite any other deficits linked to memory performance.

Acknowledgements: This work was supported by the Wellcome Trust and Biomedical Research Centre UK.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

I look forward to talking more about the study and to answering your questions during the zoom meetings! You can also contact me at oana.gurau@ndcn.ox.ac.uk

Abstract ID: 1137

Retinotopic reactivation in human visual cortex tracks memory success in a single-shot encoding paradigm

Poster Presentation - *Topic area: Visual Memory: Long term*

Serra E Favila[1,2] (sef2177@columbia.edu), Jonathan Winawer[2]; [1]Columbia University, [2]New York University

More than twenty cortical areas containing maps of the visual field have been identified. By training subjects extensively on a few memories, we previously demonstrated that these maps are retinotopically activated during long-term retrieval of spatial information (Favila et al., bioRxiv 2019). Here, we extended this work by asking three questions: 1) Is extensive training necessary to observe these results? 2) Does reactivation quality relate to memory success? 3) Does reactivation occur when spatial information is not explicitly probed? We designed a single-shot spatial memory paradigm to address these questions. First, based on subjective ratings from six subjects, we identified 480 object images that were recognizable in the near periphery. A different group of subjects (N=5) then encountered these stimuli across three scanned, interleaved tasks: encoding, recognition memory, and spatial memory retrieval. During encoding blocks, subjects were presented with objects, each of which appeared only once in one of four visual field locations. During recognition blocks, subjects were presented with previously studied and new objects at central fixation and made old/new judgments. This task did not require remembering the spatial location of the objects. During spatial memory retrieval blocks, subjects were presented with old objects at central fixation and explicitly cued to make a four alternative forced-choice decision about the location of the object during encoding. Across the visual system, we observed reliable retintopically-specific reactivation during successful, but not unsuccessful, spatial memory retrieval. We also observed incidental reactivation during successful recognition of objects for which subjects later expressed accurate spatial memory. Spatial tuning in both memory tasks was consistent with our previous work. Our results indicate that memory retrieval can evoke organized, spatially tuned activity in visual cortex, that this activity tracks recall accuracy, and that it can be observed during non-spatial memory tasks and for stimuli studied only once.

Acknowledgements: F99NS105223

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 5:00 pm EDT America/New_York

Presenter's Message

For related work, see our preprint: https://www.biorxiv.org/content/10.1101/811331v2

Abstract ID: 762

The Capacity Limit of Personal Identity

Poster Presentation - *Topic area: Visual Memory: Long term*

Julian De Freitas[1] (defreitas@g.harvard.edu), Lance J. Rips[2], George A. Alvarez[1]; [1]Harvard University, [2]Northwestern University

A cornerstone of cognitive science is that mental systems are limited: There is a maximum amount of information they can process or store, beyond which performance breaks down. Yet so far the study of such limits has focused on core systems like attention and memory— are there also limits on higher-level thinking, and can models of visual processing be adapted to account for these limits as well? Across 20 studies and over 5000 participants, we asked people to identify with imagined versions of themselves (e.g., a younger "you" vs. older "you") and found that people can only personally identify with one imagined self at a time, a limit that occurred across decision-making, visual associative learning, and visual long-term memory. In the associative learning task, participants learned associations between imagined selves and simple shapes, then the shapes were rapidly presented with either the correct or incorrect labels and participants performed rapid match-mismatch categorizations. In the long-term memory task, participants were told that various images were assigned to each of the imagined selves, then completed a surprise recall test of these associations. In both tasks, participants exhibited standard self-reference effects when they learned associations or remembered items for only one imagined self. Yet they performed no better overall when they imagined two selves rather than just one, suggesting a limit on the self-reference effect. Despite this limit, we also discovered ways in which self-related processing is flexible. For instance, long-term memory of images associated with multiple imagined selves was better when those selves were conceptually distinct ($r = 0.86$, $p = .006$). In sum, we found that the singular self-reference effect is aptly named, since it did not increase as the number of imagined selves did. More broadly, the notion of cognitive limits may hold promise for carving thinking at its joints.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 5

The association between visual working and long-term memory in apolipoprotein E (APOE) e4 carriers and non-carriers

Poster Presentation - *Topic area: Visual Memory: Long term*

Giedre Cepukaityte[1,2] (giedre.cepukaityte@psy.ox.ac.uk), Nahid Zokaei[1,2], Anna C. Nobre[1,2]; [1]Wellcome Centre for Integrative Neuroimaging, Oxford Centre for Human Brain Activity, Department of Psychiatry, University of Oxford, [2]Wellcome Centre for Integrative Neuroimaging, Department of Experimental Psychology, University of Oxford

Mechanisms underlying working (WM) and long-term memory (LTM) are not entirely coextensive: although both depend on the hippocampus for feature binding, WM also utilises frontoparietal regions for information maintenance. Hence, disorders that affect the hippocampus, such as Alzheimer's disease (AD), may affect WM and LTM differently. Apolipoprotein E (APOE) e4 allele is the highest genetic risk factor for late-onset AD. Previous research demonstrates that even healthy older carriers of this allele show impairments in LTM as compared to non-carriers, while their WM may be better, suggesting a different pattern of WM versus LTM performance in later adulthood. Therefore, we aimed at investigating whether APOE e4 alters the relationship between WM and LTM. In a double-blind study, we tested over 80 middle-aged adults genotyped for three different APOE allele combinations: e3/e3, e3/e4 and e4/e4. We used a recently developed delayed-report contextual spatial memory task to measure WM and LTM in an analogous way. In each trial, participants viewed a photograph with either one or three objects superimposed on it, followed by a memory delay. They were then either probed to report the location of one of the objects (WM trials) or asked to tap on a centrally presented fixation cross (learning trials). The LTM stage followed 20 minutes later with an identical memory probe of all previously seen stimuli, supplemented by confidence rating scales (LTM trials). We measured response times and memory errors, the Euclidian distances between the original and the reported locations. The analysis per gene group is soon to be completed following the unblinding. However, a preliminary analysis of all data showed that the task worked as expected: larger set size increased reaction times in WM and memory errors in WM and LTM trials, while WM performance significantly predicted LTM performance. This promises interesting results for gene group analysis.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1121

The context account does not explain why remembering some pictures leads to forgetting others

Poster Presentation - *Topic area: Visual Memory: Long term*

Emily Kopec[1], Matt Becker[1], Ashleigh Maxcey[1]; [1]Vanderbilt University

When we access a visual long-term memory representation, one of the unintended consequences is that we forget related representations. What is driving this forgetting? One theoretical explanation for this phenomenon is that there is a shift in context during these experiments, driving the forgetting effect. This explanation hinges on the fact that in previous experiments demonstrating this forgetting effect, the exposure to pictures of objects unfolds across three phases. In the first phase the objects are studied, in the second phase some items are shown again in an old-new recognition judgment task, and in the third phase visual long-term memory for all the pictures is tested. The context account argues that during the third and final test phase, people activate the context of the second phase to search their memory, because is the most temporally recent context. This contextual activation during the third test phase causes problems remembering the items shown only during the first study phase. The context account makes the clean prediction that if the first phase were reactivated, the apparent effects of forgetting should disappear. Thus, we created distinct contexts for the study and practice phases, either of which could then be reactivated at test. Across two experiments we found reliable forgetting effects, regardless of which context was activated. These results challenge contextual theoretical accounts of the forgetting of visual long-term memory representations.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1796

The influence of long-term memory on working memory performance

Poster Presentation - *Topic area: Visual Memory: Long term*

Stephanie Saltzmann[1] (ssaltz2@lsu.edu), Melissa Beck[1]; [1]Louisiana State University

The current research examined if previously stored representations in LTM necessarily aid working memory performance. Research has suggested that long-term memory representations for abstract colored shapes

can facilitate WM performance when they are identical to representations in WM. A second goal of the study was to determine whether increasing interference in LTM limits facilitation from LTM on WM. Remembering multiple stimuli from the same semantic category can create interference in LTM that may decreases the accessibility of LTM representations during a WM task. In two experiments, participants completed an initial study phase in which objects were categorically (i.e., semantically) related or unrelated. Participants then completed a change detection task that included both previously studied and unstudied objects. In Experiment 1, an object changed into another object from a novel category. We found no evidence of facilitation from LTM on WM performance, as displayed by similar change detection accuracy for studied and unstudied pictures. Furthermore, we found no effect of semantic-relatedness. Change detection was similarly accurate when the studied objects were all semantically-unrelated, as when the studied objects were semantically-related, demonstrating that interference in LTM did not affect WM. In Experiment 2, we attempted to increase reliance on LTM representations by increasing difficulty in the WM task. The changed object on the post-change array came from the same category as the pre-change object. Like in Experiment 1, we did not find any evidence of LTM facilitation on WM performance: change detection accuracy was similar for studied and unstudied objects. Additionally, there was no effect of interference in LTM on WM performance: change detection accuracy was similar for semantically-related objects and semantically-unrelated objects. Therefore, for WM tasks with real-world objects identical to objects previously encoded into LTM, we can conclude that the LTM representations were not used to improve WM performance.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

contact either ssaltz2@lsu.edu or mbeck@lsu.edu

Abstract ID: 292

The road to long-term memory: Top-down attention is more effective than bottom-up attention for forming long-term memories

Poster Presentation - *Topic area: Visual Memory: Long term*

Edyta Sasin[1] (edytasasin@gmail.com), Daryl Fougnie[1]; [1]New York University Abu Dhabi

We see billions of objects every day, but only some of these get encoded into long-term memory (LTM). There is strong evidence that attention is critical for LTM encoding. However, attention is not a unitary construct. Does the strength of representations in LTM depend on which type of attention is engaged? We

tested participants' memory for objects seen during visual search. Specifically, on every trial, participants searched for an object of a specific color among distractor objects. To manipulate the type of attention, two types of distractors were shown in this task: related-context distractors that grabbed attention because they matched the target defining feature (i.e. similar color; top-down attention) and salient distractors that captured attention only because they were perceptually distracting (bottom-up attention). In Experiment 1, the salient distractor flickered, while in Experiment 2 and Experiment 3, the flickering was replaced by alternations in luminance to generalize over distinct methods of introducing stimulus salience. Both the context-related and salient distractors led to slower search compared to the baseline condition, in which none of these distractors was presented. Critically, in all experiments, we found that salient and related-context distractors produced equivalent attentional capture, yet related-context distractors were remembered better than salient distractors (and salient distractors were not remembered better than unrelated distractors - Experiment 2). Interestingly, the benefit for top-down attention trials over bottom-up attention trials extended to the search targets, demonstrating that the benefit for context-related distractors did not come at the cost of worse memory for targets (Experiment 3). Taken together, these results show that LTM not only depends on the amount of attention but also on the type of attention that is engaged. Specifically, top-down attention is more effective in promoting the formation of memory traces than bottom-up attention.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
21 June, 9:00 am EDT America/New_York
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 765

Visual long-term memory for image style

Poster Presentation - *Topic area: Visual Memory: Long term*

Yana Yu[1], Yuki Takeda[1], Hiroyuki Tsuda[2], Jun Saiki[1]; [1]Kyoto University, [2]National Institute of Advanced Industrial Science and Technology

Previous studies have shown systematic bias in memory for visual information such as color, orientation and location. For instance, a study on visual working memory for color using method of adjustment found that responses drawn from working memory are significantly biased away from category boundaries and toward category centers (Bae, Olkkonen, Allred, & Flombaum, 2015). However, it is unclear whether

systematic bias also occurs in memory for high-level visual features, such as the style of an image. Here we investigated long-term memory for image style using a method of adjustment. The style transfer algorithm based on deep learning (Gatys, Ecker, & Bethge, 2016) was used to convert scene photos into painting-like scene images. Based on painting styles of four well-known artworks (Rembrandt, Braque, Monet and Kandinsky), we created image series (72 image styles for each of 72 scenes) in which the style of painting changes continuously. The experiment consisted of a learning phase and a test phase, between which there was a 30-minute interval. In the learning phase, participants looked at 72 scene images, and each of the images was shown for 10s. Participants were asked to memorize the content and style of every scene image. In the test phase, the same set of scenes was shown in different styles from the learning phase, and participants adjusted the image styles to reproduce those appeared in the learning phase. Response frequency data show that more responses were made for near-prototypical stimuli, compared with mixed-style stimuli. The bias in the current study is different from that we found in a previous short-term memory experiment of image style, which showed fewer response for near-prototypical style, and more response for mixed-style stimuli. Taken together, the current study suggests that systematic bias also exists in memory for high-level features like image style.

Acknowledgements: This research was supported by JSPS KAKENHI Grant Number 18H05006.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 641

Visual Memory: Objects, features

ERP Decoding of Low-and-High-Contrast Orientations: Implications for Awareness of Low Level Sensory Representations

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Lara Krisst[1] (lckrisst@ucdavis.edu), Steve J. Luck[1]; [1]Center for Mind & Brain, University of California, Davis

Even though neurons in early visual areas respond in a contrast dependent manner, we can consciously perceive a stimulus even at relatively low contrast. To test the hypothesis that the precision of these high-

level representations remains relatively constant at low levels of contrast, we conducted two experiments. The first was a psychophysical experiment to demonstrate that at low contrast people could have a precise representation of an oriented-teardrop-shape. Teardrop-shaped stimuli were presented as dark stimuli on a grey background. One stimulus was black (86% contrast), while the other two stimuli were only slightly darker than the background (.8%, 1.8% contrast). Participants were instructed to remember the orientation of the teardrop and to reproduce it after a 1500ms delay. We found that as the contrast level was reduced the precision was unaffected, although at the lowest contrast we saw an increase in the guess rate. We then performed an ERP decoding experiment where we examined the ability to decode the orientation of the stimulus from the scalp distribution of the ERP at each moment in time following the onset of the stimulus. This task was similar to the behavioral task, with slight modifications. This allowed us to test the hypothesis that early sensory activity would be reduced and therefore undecodable at low contrast, whereas later, higher-level processing (presumably conscious) would be decodable in both high and low contrast conditions. Results were consistent with our hypothesis, showing that during the early sensory period (~50-150ms) decoding accuracy was higher for high contrast than low contrast. By 200ms, decoding accuracy was equally high for low contrast stimuli as for high contrast stimuli. These findings suggest that early visual areas are not encoding the conscious perception of orientation, but awareness instead requires iterative processing over time to extract a largely contrast independent perception of orientation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1694

Great Expectations: Evaluating the Role of Object-Color Expectations on Visual Memory

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Kimele Persaud[1], Elizabeth Bonawitz[1]; [1]Rutgers University - Newark

Previous research has shown that category expectations can improve recall of information from visual memory, by reducing absolute average error (e.g. Huttenlocher, Hedges, & Duncan, 1991; Hemmer & Steyvers, 2009). In most of this work, category expectations, on average, produce improvements, particularly when expectations directly align with studied information (e.g. using category knowledge of ‘red’ to help recall shades of ‘red’). However, a growing body of research is finding that expectation-violations may also boost memory. Here we explore whether having expectations also improves recall

when studied information does not align with those expectations, through mechanisms of expectation-violation, like outlier effects or surprise. To explore whether having an expectation mismatch (e.g. studying a banana that is not yellow) boosts the perceptual memory trace and thus accuracy for the color of studied items, we employed a cued recall task, where we manipulated the degree to which the color of studied objects aligned with people's (N=19) expectations. The object-color pairs varied in two important ways: 1) some objects had strong color expectations (e.g. yellow bananas, red stop signs), and other objects did not ("no matches" --e.g. fish, shirt, etc. can be many different colors). 2) for objects with expectations, we varied whether they were paired with their expected color ("expected-match"), a somewhat unexpected color ("weak mis-match"-- e.g. orangish-yellow banana), and a completely unexpected color ("strong mis-match"-- e.g. purple banana). Our preliminary results show greater recall accuracy (less absolute error) for expected-matches compared to no matches, and mis-matches. However, there was no difference in accuracy between mis-matches and no matches, nor was there a difference between weak and strong mis-matches. As a first pass, this work potentially shows that the benefit of category expectations might not extend to instances when studied information is misaligned with those expectations.

Acknowledgements: This work was funded by an NSF Postdoctoral Research Fellowship (NSF -SMA 1911656) to KP

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1539

Investigating how illusory objects are represented in visual working memory

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Elliot E.C. Ping[1], Lisa M. Heisterberg[1], Ayala S. Allon[1], Andrew B. Leber[1]; [1]The Ohio State University

Visual Working Memory (VWM) is an online workspace that holds a limited amount of information, about 3-4 objects, in an active state for a short period of time (Luck & Vogel, 1997). A way to cope with such capacity limitations is to group and parse information into integrated units in VWM. Gestalt grouping cues, such as illusory objects, have previously been shown to improve VWM performance (Allon et al., 2018, Gao, et al, 2016; Peterson, et al, 2015). While illusory objects clearly lead to behavioral improvements, the question of how these improvements arise remains unanswered. Here, we ask whether the behavioral

benefits derived from an illusory object (eg., a Kanizsa triangle) result from a reduction in storage demands in VWM. We recorded EEG while subjects performed a bilateral change-detection task, with memory arrays configured in four conditions: 1 item, 3 items forming a Kanizsa triangle, 3 proximity grouped items, and 3 ungrouped items. The number of items held in VWM was assessed via the contralateral delay activity (CDA). We found a behavioral performance benefit for the Kanizsa triangle condition, replicating other studies. However, the CDA amplitude for the Kanizsa condition was not significantly different from the 3 proximity grouped and 3 ungrouped item conditions. These results suggest that the behavioral benefits derived from the illusory object Kanizsa triangle are not a result of reduced storage demands in VWM. Future follow-up studies will aim to further delineate how the behavioral benefits of the Kanizsa triangle arise.

Acknowledgements: NSF BCS-1632296 (AL), NSF BCS-1848939 (AL)

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1467

Object-based memories revealed by whole-report for dual-feature stimuli

Poster Presentation - *Topic area: Visual Memory: Objects, features*

William Ngiam[1] (wngiam@uchicago.edu), Krystian Loetscher[1], Edward Vogel[1], Edward Awh[1]; [1]University of Chicago

Understanding the factors that mediate visual working memory (VWM) performance is of great interest. For instance, recall for dual-feature stimuli tends to be less accurate than for single feature stimuli. Although the cost of an additional feature is not large enough to support a pure feature-load account of WM storage limits, this empirical pattern challenges models that posit no cost for doubling the feature load in a VWM task. We examined this question while taking advantage of a new analytic technique that distinguishes between the maximum number of items that can be stored in VWM (max storage parameter: Kmax) and the probability that one will achieve that maximum (attention parameter: a). We employed a whole-report task in which subjects attempted to recall the features of all six stimuli in each trial. Subjects stored either color alone, orientation alone, or both the color and orientation of each stimulus. Replicating past work, subjects made more errors in the dual-feature condition compared to single-feature conditions.

However, the total number of features stored was approximately 40% higher in the conjunction condition, suggesting an “object-based” benefit for storage. Moreover, the maximum number of items for which subjects stored at least one feature was equivalent in the single feature and conjunction conditions, in line with the hypothesis that VWM storage is limited by the total number of items rather than by total feature load. Finally, we examined whether storage of multiple features within a single object was associated, such that storage of one feature predicted successful storage of the other. Given one feature was reported accurately, the other feature was correctly reported approximately two-thirds of the time. Increased numbers of features stored from dual-feature objects, and covariations in the storage of each feature within an object, point towards a central role of object-based representations in VWM.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

You can view my 6 minute video summary of my poster here: https://youtu.be/ByDhxxk51Yc

I would love to hear your feedback on this project! You can contact me via Twitter (@will_ngiam) or via email (wngiam@uchicago.edu)

Abstract ID: 1546

Object-based selection in memory

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Yin-ting Lin[1] (jenny.yt.lin@nyu.edu), Garry Kong[2], Daryl Fougnie[1]; [1]New York University Abu Dhabi, [2]University of Cambridge

Attention allows cognition to focus on task-relevant items at the expense of others. While selection over visual input has been extensively studied, attention also operates on information in the mind. To what extent do the mechanisms and properties of mental selection mirror those of perceptual selection? One of the organizing principles of perceptual attention is that it is influenced by how individual features and parts are grouped as integrated objects. Here we ask whether selection in working memory is object-based by utilizing two influential paradigms in visual attention. In Experiment 1, we adapted the double-rectangle paradigm (Egly, Driver, & Rafal, 1994) into a memory updating task where participants memorized colored squares at the end of two different bars and simultaneously updated the colors of two target squares within memory. Updating targets on the same object is faster, $F(1,16) = 6.78$, $p = .019$, and more accurate, $F(1,16) = 5.35$, $p = .034$, than updating those on different objects even when the distance between targets

are the same. In Experiment 2, we examined the spread of attention to task-irrelevant features in a retro-cue task. Participants memorized colored Gabor patches that were sequentially presented and received both an item and a feature dimension cue (color or orientation) with 70% validity. We found a main effect of cue validity, $F(2,15) = 12.49$, $p < .001$. There are lower errors in an adjustment task for validly cued trials than both the invalid same-feature, $p = .002$, and invalid same-object trials, $p = .016$. Importantly, we found evidence for object selection over feature selection: Participants were more precise in the invalid same-object condition than in the invalid same-feature condition, $p = .005$. Together these findings show that selection in working memory is similar to visual attention in that it acts on coherent, bound objects.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York
22 June, 1:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 688

Role of time in binding features in visual working memory

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Sebastian Schneegans[1] (ss2361@cam.ac.uk), Jessica McMaster[1], Paul Bays[1]; [1]University of Cambridge

Previous research on feature binding in visual working memory has supported a privileged role for location in binding together non-spatial features of an object, such as shape and color. However, humans are able to correctly recall feature conjunctions of objects that occupy the same location at different times. In a series of behavioral experiments, we investigated binding errors under these conditions. In particular, we tested the hypothesis that sequential position can take the role of location in mediating feature binding. In two experiments, participants viewed three colored shapes presented sequentially at the screen center. They were then cued with either a visual feature of one of the objects or a number indicating its position in the sequence, and had to report the remaining object properties. We found that report errors for color and shape were largely uncorrelated when participants were cued with an item's sequential position. However, when participants were cued with e.g. an item's shape and reported an incorrect sequential position, they had a high chance of also making the corresponding error in reporting the item's color. These patterns of binding errors across conditions matched the predictions of a model in which binding between color and shape is mediated by the binding of each individual feature to an object's sequential position. In a third experiment, we directly compared the roles of location and sequential position in feature binding under

conditions where both are available. Participants viewed a sequence of colored disks displayed at different locations, and were cued either by a disk's location or its sequential position to report its remaining properties. The pattern of errors supported a mixed strategy with individual variation, suggesting that binding via either time or space could be used for this task.

Acknowledgements: This research was supported by the Wellcome Trust.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1132

The effect of holding multi-feature ensemble in visual working memory on perception

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Yong Min Choi[1] (minius93@yonsei.ac.kr), Jieun Cho[1], Sang Chul Chong[1,2]; [1]Graduate Program in Cognitive Science, Yonsei University, [2]Department of Psychology, Yonsei University

Extracting global properties of a scene is very fast and sometimes possible without intention under a distributed attention mode. A previous study showed that the mean size computation is also biased by a set of irrelevant items that should have been ignored for accurate performance (Oriet & Brand, 2013). The current study investigated whether ensemble information from multiple feature dimensions (orientation and color) can be represented simultaneously and separately for each feature regardless of task relevance. We used a paradigm that examines how feature information held in VWM alters subsequent perception of the corresponding feature dimension depending on the task relevance (Teng & Kravitz, 2019). Using a single stimulus with multiple features, they showed that the content of VWM influenced the discriminability of subtle stimulus differences only when the feature dimension for the perceptual task was relevant to the maintained feature in VWM. Instead of a single stimulus, we used a set of Gabors comprised of heterogeneous orientations and colors. Participants were asked to attend to only one feature dimension when seeing Gabors and remember the mean of the designated feature. During the maintenance, they performed a perceptual discrimination task on one feature dimension which was either same (i.e., task-

relevant) or different (i.e., task-irrelevant) with the VWM task, resulting in four combinations of between-subject conditions. Results showed that, regardless of task-relevance, orientation ensemble information of the memory task display affected subsequent orientation discriminability while color ensemble information did not. However, after excluding the trials where the memory task display was perceived as having two distinct colors, we found a similar tendency for color ensemble information as in the orientation feature. These results suggest that statistical information from multiple feature dimensions can be simultaneously extracted and affect future perception.

Acknowledgements: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (NRF-2019R1A2B5B01070038).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1736

The role of object files in visual working memory: Facilitating integration over longer timescales for moving objects

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Yong Hoon Chung[1] (yhc036@ucsd.edu), Mark Schurgin[1], Timothy Brady[1]; [1]UC San Diego

While most visual working memory studies use static stimuli with unchanging features, in the real-world objects are often dynamic, introducing vast differences in the surface feature information hitting the retina from the same object over time (e.g. changes in orientation, lighting etc). While previous research has shown that change detection is improved if objects obey the rules of physical motion (e.g., Flombaum & Scholl, 2006), here we investigated whether object motion facilitates greater temporal integration of continuously changing surface information in working memory, resulting in a more accurate estimate of an object's surface feature information. To evaluate this hypothesis, in Experiment 1 participants (N=33) viewed either one or two circles that were continuously changing colors (2 degrees per frame clockwise of a preset color wheel) for several seconds. At an unpredictable time, the colors disappeared and participants had to report the final color using a color wheel. On half of the trials, the circles physically moved along predefined circular paths on the screen; on the other half of the trials, the circles remained static. We found that the reported color "lagged behind" the physical state of the dots, and that this was more profound when the dots moved than when they were stationary. Critically, we observed that the accuracy

of memory responses was significantly better for items in the moving condition compared to the stationary condition, consistent with our hypothesis that object motion facilitates integration of object information. We replicated and extended these results in a second experiment, which utilized slower object movement speeds and slower color changes (N=30). Together, our data suggest that memory representation is improved —but lagged — for moving objects. This is consistent with an account that motion assists in greater temporal integration and may assist in creating enduring object files.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1208

Visual Working Memory Representations: Discrete Bindings of Continuous Features

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Qian Yu[1] (qianyu@jhu.edu), Justin Halberda; [1]Johns Hopkins University

Visual Working Memory (VWM) functions as an interface between higher cognition (e.g., reasoning, decision making) and perception. As such, we predict that the representations of VWM will have both a continuous component (i.e., to interface with continuous feature spaces in perception) and a discrete/symbolic component (i.e., to bind multiple features into a structured representation). To explore this hypothesis, we sought to manipulate both discrete binding and continuous features. We presented participants with a rapid serial visual presentation (RSVP) paradigm of two adjacent squares changing colors either monotonically (continuous condition - changing in one direction along the color wheel), or randomly (random condition - changing randomly across values of the color wheel). Participants were asked to report the colors of a briefly cued target-pair from the middle of the sequence. To minimize verbal coding of the colors, participants performed verbal-shadowing of a steam of words which they were required to repeat out loud. We predicted a larger bias (i.e., shift from the true target color) in reporting the target colors in the continuous condition relative to the random condition and a control condition - because of lag under continuous change. In contrast, we predicted more swaps (i.e., reporting its counterpart's color for a color in the pair) in the random condition than in the continuous condition and the control condition - because random changes will disrupt binding. Consistent with our predictions, mixture model fitting revealed a

larger bias in the continuous condition and a repeated-measure ANOVA showed more swaps in the random condition. This pattern of bias and swaps would not have emerged if VWM lacked either continuous or discrete representations respectively. Hence, we suggest that VWM representations consist of two different components — continuous representations for individual features and discrete symbolic representations for the bindings of features.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

Feel free to contact me!
qianyu@jhu.edu

Abstract ID: 1280

Visual and semantic similarity norms for a new object and scene photographic image set

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Zhuohan Jiang[1] (ajiang@smith.edu), D. Merika W. Sanders[2], Rosemary A. Cowell[2]; [1]Smith College, [2]University of Massachusetts, Amherst

Photographic images of objects and scenes are widely used as stimuli in studies of memory and perception, in both behavioral and neuroimaging paradigms. Many repositories for color photographs of objects and scenes are publicly available, offering a range of valuable features such as standardized photographic composition (e.g., viewing and illumination angle), large numbers of exemplars in specific sub-categories (e.g., animate/inanimate; indoor/outdoor; everyday objects; faces), or standardized visual features (e.g., Greebles; stimuli normalized for low-level image properties). However, most of these sets do not provide quantitative data about the subjective relations between images within a set from the perspective of a human observer, i.e., perceptual and semantic similarity. This information is valuable because stimulus similarity influences many cognitive processes. The aim of the present study was to create a database of object and scene color photographs with both visual and semantic similarity ratings among images within well-defined sub-categories of the objects and scenes. We used Amazon's Mechanical Turk to collect subjective similarity ratings – both visual and semantic – for 240 color photographs in four sub-categories (60 animate objects, 60 inanimate objects, 60 indoor scenes, and 60 outdoor scenes). Next, we implemented multidimensional scaling (MDS) to create a visual and semantic similarity space for each sub-category, and used automated clustering methods to provide similarity-based groupings of stimuli within

the sub-categories. The stimulus set, similarity ratings, and methods for analyzing and grouping the stimuli by similarity will be made publicly available.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

====== Comments? ======
If you have any questions or comments or want to chat with me in person,
Email "ajiang@smith.edu" or "audrey.jiang@mail.mcgill.ca" ! Either works!

Abstract ID: 1567

Visual memory recall for personally familiar objects in medial parietal cortex

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Alexis Kidder[1], Edward H. Silson[2], Chris I. Baker[1]; [1]National Institutes of Mental Health, [2]The University of Edinburgh

Human ventral temporal cortex (VTC) contains distinct category-selective regions that are selectively recruited during visual processing of faces and scenes. In prior work (Silson et al., 2019), we found distinct functional connectivity between these VTC regions and parts of medial parietal cortex (MPC) with corresponding differences in the magnitude of activation in MPC during visual recall of personally familiar people and places. In addition to face- and scene- selective regions, VTC also contains object-selective regions. To investigate if there is also a separate region in MPC engaged during recall of personally familiar objects we collected functional magnetic resonance imaging (fMRI) data while participants (N = 21) visually recalled from memory personally familiar people (e.g. mom), places (e.g. bedroom), or objects (e.g. laptop, cell phone, jacket). Stimuli were personalized to each participant, and they reported 12 names for each condition prior to the scan session. We specifically chose objects that were not strongly associated with a specific context (e.g. toothbrush) to avoid any contextual effects. Regions of interest (ROI) were defined across the MPC using independent resting-state data, based on functional connectivity with VTC. While the data replicated our previous finding of separate regions for memory recall of people and places, there was little activation in MPC during the recall of personally relevant objects and no distinct subdivision of the MPC that was more selective for the recall of objects then people or places. Thus, the functional organization of MPC is not a complete reflection of the visual category-selective organization of VTC.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

If you have any questions, feel free to email me at alexis.kidder@nih.gov. I'm also happy to chat over Skype/Zoom at a different time if you are unable to attend the set presentation times.

Abstract ID: 143

Visual statistical learning distorts feature memory

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Brynn E. Sherman[1] (brynn.sherman@yale.edu), Nicholas B. Turk-Browne[1]; [1]Yale University

Visual experience contains a mix of predictable regularities (e.g., the layout of offices at work and the colleagues you interact with there) and idiosyncratic features layered unpredictably on top of this structure (e.g., the weather outside and the clothes people wear). How we represent these two aspects of experience has typically been investigated separately, with statistical learning tasks used to study how we infer structure from regularities, and visual short- and long-term memory tasks treating each item de novo, isolated from stimulus history and surrounding spatiotemporal context. Here we ask how these two kinds of experience interact. We investigated how the presence of temporal regularities between objects influences visual short-term memory for idiosyncratic features of these objects. Participants were first exposed to a sequence of black shapes. Half of the shapes were temporally paired, with one shape (A) always followed by another shape (B). The other half of shapes (X) were unpaired and could be preceded or followed by many possible shapes. After being familiarized with this structure, participants completed a visual short-term memory task. On each trial, they were shown a rapid series of four shapes, each in a unique and random color. Participants were then probed with one of the shapes and asked to reproduce its color from that trial. Each set of four shapes on a trial contained one A/B pair and two unpaired X items, allowing us to assess the influence of temporal predictability on color memory. Using mixture modeling, we found that color memory was more precise for X shapes than for both A and B shapes. Preliminary analyses suggested that color reports for A and B shapes may be biased away from each other in color space. Together, these data suggest that learned regularities may interfere with encoding of idiosyncratic details into visual memory.

Acknowledgements: NSF GRFP; NIH R01 MH069456; CIFAR

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 174

What's the status of the relationship between complexity and dimensionality in visual working memory? It's complicated.

Poster Presentation - *Topic area: Visual Memory: Objects, features*

Joel Robitaille[1], Stephen Emrich[1]; [1]Brock University

Working memory (WM) has been studied extensively for the past few decades relying on tightly controlled stimuli that varied based on 2D surface features (e.g., color, orientation, etc.). Although there are some attempts at assessing WM for more complex items, most studies have reported mixed results from dichotomous choice paradigms. Moreover, real-world objects have dimensionality, and are often highly complex, and yet studies have reported increases in performance when compared to abstract items. Thus, the effects of complexity and dimensionality on WM performance remains unclear. In this study, we used a continuous report, delayed-recall task to evaluate the psychophysical properties of memory representations for stimuli that vary in complexity/dimensionality. In Exp.1 (N=45), we used a load manipulation (i.e.,1,2, or 4 items) in which participants were required to report the orientation of a either simple lines or complex 3D stimuli. Overall recall error was worse for complex 3D shapes than for lines. Moreover, using a mixture model, we demonstrate only guess rates are affected by complexity. A Bayesian model selection analysis confirmed that that for most participants precision increased with set size for both simple and complex shapes, whereas guess rates increased only for the complex stimuli. In Exp.2 (N=55), we compared delayed-recall performance for simple lines, complex 2D stimuli and 3D stimuli. WM capacity(k) was also obtained using a change-detection task for all stimuli, as well as for colored squares. Results corroborate the findings from Exp.1, and demonstrated reduced performance for complex 2D stimuli compared to similar 3D stimuli. Partial correlations, controlling for color or line capacity, also revealed some stimulus-specific effects on recall performance independent of general memory capacity. Together, these results demonstrate that complexity and dimensionality have different effects on VWM performance, and also reveal that some aspects of performance on a delayed-recall task may be stimulus specific.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1317

Visual Memory: Space, time, attention

Changes in V4 sensory processing after frontal eye fields inactivation

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

M Isabel Vanegas[1] (martaisabelv@gmail.com), Behrad Noudoost[1]; [1]Department of Ophthalmology and Visual Sciences, University of Utah, Salt Lake City, UT

Working memory (WM) is the ability to form and keep internal representations to pursuit a behavioral goal. Recent findings have shown that, through direct projections from the frontal eye fields (FEF), a prefrontal cortical area involved in working memory and attention, WM modulates the gain of sensory signals in visual area V4. We investigated the contribution of FEF on the influence of WM on visual sensory processing within V4. We identified V4 and FEF areas with overlapping response fields (RFs). FEF RFs were confirmed with electrical microstimulation (50µA) and V4 RFs were mapped by assessment of the neuronal firing rate in response to visual stimulus presentation. We pharmacologically inactivated FEF by infusing 0.5-1µL of muscimol (5mg/mL) while recording from overlapping V4 neurons using single electrode and linear array probes. Before and after FEF inactivation, the animal performed a memory guided saccade with a task-irrelevant grating background of varying contrasts and orientations, and a passive fixation task tailored for RF mapping. Preliminary findings show that before inactivation, WM alters the orientation tuning and contrast response function at the level of single neurons, such that more effective stimuli are more strongly modulated by WM. After inactivation of the FEF, the animal showed striking behavioral deficits in memory guided saccades and increased saccade scatter at the RF location. V4 neurons with overlapping RF with the behavioral scotoma, showed changes in their contrast sensitivity and orientation tuning, indicative of a necessary role for the FEF to exert WM-dependent modulations of visual signals within V4. Furthermore, after FEF inactivation, V4 RFs became larger and less spatially selective, an indication of FEF's role in shaping the spatial sensitivity of V4. Behavioral effects confirm previously reported findings. Neural findings show the importance of FEF signal for spatial and featural sensitivity within V4.

Acknowledgements: This work was supported by funding from the National Institutes of Health (NIH) grants EY026924 and EY014800, and also an Unrestricted Grant from Research to Prevent Blindness, Inc., New York, NY to the Department of Ophthalmology and Visual Sciences, University of Utah.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1348

Everything seems to be in order: Effects of sequential presentations on visual working memory

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Harun Yörük[1] (harunyoruk42@gmail.com), Benjamin Tamber-Rosenau[1]; [1]University of Houston

Recent research has sought to determine if visual working memory (VWM) representations are subject to the same limitations as perceptual representations. Harrison & Bays (JNeurosci, 2018) and Yörük & Tamber-Rosenau (OPAM, 2019) investigated whether, like simultaneously presented perceptual items, VWM representations of sequentially-presented memoranda exhibit radial/tangential crowding anisotropy. No anisotropy was observed. However, a previous study using simultaneously-presented items did find additional crowding effects in VWM over and above those observed in perception (Tamber-Rosenau, Fintzi & Marois, PsychSci, 2015). It is possible that these discrepant results stem from a difference between simultaneous and sequential stimuli; specifically, the sequential paradigm is more complicated and might lead to order effects that, if not taken into account, could affect conclusions. Previous VWM studies with sequential paradigms that analyzed order found crowding in sequential presentations, but more ambiguous effects of order (Ahmad et al., SciRep, 2017, their Experiment 5), or they did not report order effects (Harrison & Bays, 2018). Here, we reanalyzed the Yörük & Tamber-Rosenau (2019) data with additional data collected since, as well as the Harrison and Bays (2018) data. In both cases, we found significant order effects in which errors diminished from the first to last item. This is consistent with a previous study showing that VWM representations shift from occipital visual cortex to parietal and frontal brain areas with delay and presentation of additional memoranda (Vergauwe et al., Psychonomics, 2019). It also accords with the finding that occipital, but not parietal, VWM representations are modulated by the presence of distractors during VWM maintenance (Bettencourt & Xu, NatNeurosci, 2016). Therefore, care should be taken in interpreting the presence/absence or quality of cross-item interactions such as crowding in sequentially-presented VWM arrays because these arrays may reflect storage of different items in distinct VWM states or representations.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1264

Multiple reference frames for oculomotor contributions to visual working memory in an immersive and unconstrained virtual reality environment

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Dejan Draschkow[1], Anna C. Nobre[1], Freek van Ede[1]; [1]Oxford Centre for Human Brain Activity, Wellcome Centre for Integrative Neuroimaging, University of Oxford

When we direct covert attention in external visual space, microsaccades tend to become biased in the corresponding direction. We recently showed that this “gaze bias” persists even when directing attention to items within the internal space of visual working memory. Here we investigated this bias in a virtual reality (VR) setting to address two key outstanding questions. First, this tight coupling between the brain’s oculomotor system and attentional focusing is usually investigated in laboratory tasks with restrained head movements. Using VR, which allows participants to freely move their head, we demonstrate that focusing internal attention to locations in memorized space is still associated with a gaze bias in the same direction. This reveals that the involvement of the oculomotor system in internally directed attentional focus persists under more ecologically valid conditions without head movement restriction. Second, directly capitalizing on this observation, we were able to investigate how, following locomotion (again enabled by the VR setting), we maintain and select memorized visual shape information through memorized spatial locations. This revealed oculomotor contributions to both maintenance and selection of items in working memory, which relied on both the original and the updated locations of these items in 3D space. This opens exciting new avenues for investigating how we maintain and select items in working memory in ecological and immersive 360-degree environments.

Acknowledgements: This work was supported by The Wellcome Trust 104571/Z/14/Z (to A.C.N.). The Wellcome Centre for Integrative Neuroimaging is supported by core funding from the Wellcome Trust (203130/Z/16/Z).

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 4:00 am EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Happy to talk more about the study during the zoom meetings! Or just shoot me an email: dejan.draschkow[at]psych.ox.ac.uk (more ways to contact me on: https://www.draschkow.com/).

If you want to see more work on working memory in natural settings, check out: "The cost of utilizing working memory under natural constraints" (ID=1034; Kallmayer, Melvin).
For virtual reality work on how structural building blocks guide attention and movement have a look at ID=573 (Helbing, Jason).

Abstract ID: 526

Natural variation in the representational fidelity between multiple working memory items can explain which item guides attention

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Jamal R. Williams[1] (jrw002@ucsd.edu), Timothy F. Brady[1], Viola S. Stoermer[1]; [1]University of California San Diego

When holding a single item in working memory, visual attention is automatically guided towards objects that match its features, but results are mixed as to whether multiple concurrently stored items can also guide attention. These results are relevant to models of attention and working memory use the single-item guidance account as evidence for the structure of working memory comprising distinct states where one item is prioritized over all others (i.e., a special focus of attention). However, previous studies give little consideration to how memory strength for individual items affects guidance. We therefore test how multiple items interact with attention and how memory fidelity influences this relationship. Participants remembered one or two colors, then performed a visual search task, and finally reported one of the memory items using continuous report. We found reliable guidance when participants remembered one or two items, but the multiple-item effect could be explained by guidance from only one of the items on a proportion of trials. In Experiment 2, by precisely measuring memory for individual items, we show that items naturally vary in their representational fidelity, and that in general only items with the strongest representation guides attention. In Experiment 3, we demonstrate that no distinct states in working memory — i.e., no special focus of attention — is necessary to explain these single-item guidance effects. Instead, natural variation in representational fidelity between items can explain why some items have better memories than others and why those items guide attention. In particular, only very strong memories guide attention, and it is rare for more than one item to have such strong fidelity. These findings challenge

current models of working memory and attention by suggesting that natural variation in representational fidelity, instead of distinct and prioritized memory states, determine which item guides attention on any given trial.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Welcome to my poster! I'd love to talk more about this project and this literature in general at any one of my conference presentations. If these times don't work please feel free to email (jrwilliams@ucsd.edu) or @me on twitter (@jamalamaj). Check out the preprint for complete details on the project: https://psyarxiv.com/c4t92/

Abstract ID: 1616

Retro-cue benefits across time

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Paul Zerr[1] (p.zerr@uu.nl), Surya Gayet[1,2], Stefan Van der Stigchel[1]; [1]Utrecht University, [2]Radboud University Nijmegen

Human observers can maintain multiple items in working memory. Unequal allocation of attention during memory encoding may lead to differences in how susceptible these memoranda are to visual interference. Even after the visual input is no longer available, observers can shift attention within the contents of working memory. This reallocation of attentional resources within working memory is often studied by means of a retro-cue, presented after offset of the memory array and indicates which item will be tested in a subsequent memory task. The retro-cue allows observers to prioritize this item, and shield it from visual interference, thus increasing memory performance compared to a post-cue condition, in which the test item is cued at the onset of the memory task. Such a retro-cue benefit, however, is not observed in all participants or in all studies. It often requires many trials before retro-cue benefits emerge, and some subjects seem to never demonstrate a retro-cue benefit. In this experiment, we investigated how much training is required for a reliable retro-cue benefit to emerge. Observers performed a change detection task for 10 hours over 7 days. Retro-cue benefits surpassed 5% in 9 out of 10 observers, emerged after about 250 trials on average and continued to increase until about 500 trials. However, we also observed large differences between subjects in required training time and final magnitude of the retro-cue benefit. We found that the retro-cue benefit typically reached a plateau after some time, while accuracy and associated measures of memory capacity (surprisingly) continued to increase in both the post-cue and the retro-cue

condition even after 10 hours of task performance. Our results cast doubt on the idea of working memory capacity as a stable property of an observer and suggest that studies employing a retro-cue should always be prefaced by a training session.

Acknowledgements: This research was funded by a VIDI Grant 45213008 from the Netherlands Organization for Scientific research to Stefan Van der Stigchel.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 689

Spatial modulation of feature-based interaction between working memory and perception

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Chunyue Teng[1] (cteng5@wisc.edu), Bradley R. Postle[1]; [1]University of Wisconsin-Madison

Content in working memory (WM) has been shown to interact with attentional selection (e.g., Olivers, Meijer, Theeuwes, 2006) and alter perceptual processing (Teng & Kravitz, 2019) in a stimulus-specific way, potentially through the shared recruitment of sensory cortices for perception and WM maintenance (sensory recruitment model; D'Esposito & Postle, 2015; Postle, 2015; Serences, 2016). Here, we directly tested the spatial specificity of this interaction with a psychophysical task. We predicted that if a feature maintained in WM is retinotopically organized, its influence on perception would be spatially specific. Alternatively, if WM activates feature channels globally similar to feature-based attention (Ester, Serences, & Awh, 2009), its influence would not be constrained by location. In a dual-task paradigm, observers first viewed simultaneous presentation of two oriented sample gratings, one on each side of central fixation, with a central cue indicating which one to remember. Next, a distinct discrimination grating appeared and subjects reported its orientation (left/right). Finally, they recalled the orientation of the cued sample. The discrimination stimuli either matched or mismatched the location and/or the orientation of the cued sample. The contrast of the discrimination gratings was manipulated to derive the contrast threshold to reliably perceive the orientation of the interleaved stimuli. We found that an orientation match between WM and discrimination stimuli boosted the perceived contrast of the interleaved stimuli only when their

locations also matched. The contrast threshold was significantly lower in the orientation-match/location-match condition than the others. Furthermore, on location-nonmatch trials, recall precision declined, suggesting that shifting attention away from an item's location might disrupt context-binding in visuo-object WM. These results suggest that the representation of location context in WM draws on the same resources used for the perception and discrimination of visual objects.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Welcome to my poster. I will be holding another zoom meeting on June 22, 3:00 pm - 3:40 pm.

Time: Jun 22, 2020 03:00 PM Eastern Time (US and Canada)

Join Zoom Meeting
https://zoom.us/j/95259619384?pwd=YzIwR0tuZVhzQUp2REZ5SjFNYkFQQT09

Meeting ID: 952 5961 9384
Password: 0W9GrS

Abstract ID: 778

The Temporal Dynamics of Working Memory Maintenance in a Category-Based N-Back Task

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Oliver Ratcliffe[1] (oxr772@student.bham.ac.uk), Bernhard Staresina[1], Kim Shapiro[1]; [1]University of Birmingham

A popular theoretical framework suggests theta-gamma coupling facilitates the short-term retention of multiple items in working memory (WM). According to this model, items are represented by gamma bursts occurring sequentially during the upstate of ongoing theta waves. Whereas increasing evidence points to the involvement of these two frequency bands, the evidence does not directly reveal specific content being maintained within one theta cycle. To address this question, we employed multivariate pattern analyses (MVPA) to track reactivation of category-specific working memory representations over the course of an N-Back task. Twenty-eight subjects (aged 18-35) participated in two EEG tasks. The first task was a delayed-match-to-sample (DMS) task using three stimulus categories: faces, objects, and scenes. The second, an N-Back task, employed two of the previous categories - objects and scenes - so that faces could serve as a

neutral category for multivariate analyses. Behavioural accuracy was high across tasks. Frontal theta power during the delay scaled with WM load. However, whereas power increased from the DMS to the 1-Back, adding an item from the 1-Back to the 2-Back instead elicited a significant shift in peak power to lower theta (4-5Hz). Decoding was successful across the trial period, although maximal during stimulus presentation. On the single trial level, classifier decision values showed significant rhythmicity in theta and beta bands. Homogenous 2-back trials, those where the participant maintained two same-category items, were successfully decoded during the delay period by training classifiers on stimulus presentation in the DMS. Applying this to heterogeneous 2-back trials revealed better decoding of the most recent category over the more behaviourally relevant one. Finally, using independent assessment of object and scene evidence, we show that both category representations are reactivated during the delay period and appear to coincide, thus supporting one formulation of the framework over the proposed alternative.

Acknowledgements: Funded by an MRC IMPACT Studentship

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Feel free to shoot me an email at OXR772@student.bham.ac.uk or join for the scheduled Zoom on June 22nd 14:00 (BST) if you have any questions or want to discuss something

Abstract ID: 744

The effects of product images and working memory load on eye movements

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Léon Franzen[1] (leon.franzen@concordia.ca), Corina Lacombe[1,3], Nathan Gagné[1], Onur Bodur[1], Bianca Grohmann[1], Aaron P. Johnson[1,2]; [1]Concordia University, Montreal, [2]Réseau de Recherche en Santé de la Vision, [3]University of Ottawa

The discipline of visual marketing increasingly relies on eye movements—specifically using area of interest (AOI) analyses—to better understand consumers' processing of visual stimuli in viewing, searching, and decision-making tasks. These analyses often focus on the distribution of visual attention in space and product search paradigms. The effects of moment-to-moment working memory load on visual product perception and memory for the product remain elusive. We investigated the effects of working memory load and stimulus type (i.e., numbers versus grey-scaled images of consumer products from different

product categories) using an n-Back task with four conditions of working memory load (i.e., passive viewing, 1-Back, 2-Back, 3-Back). Independent of experimental condition, stimulus presentation lasted 1.5 seconds. We compared results from AOI analysis with behavioural performance, and galvanic skin response measures to allow comparisons with marketing literature. Decision accuracy (d') was overall worse and response times longer in the image condition. Accuracy also decreased with increasing n-Back load independent of stimulus type. A generalized linear mixed effects model predicting stimulus type as a function of the AOI data revealed significant predictive power of the two factors fixation duration and fixation count, but showed opposite effects of these, with shorter but increased number of fixations on the image task. Separately, stimulus type was also predictive of gaze duration showing longer gaze duration for product images. The difference between the two tasks' fixation count was correlated with the difference in behavioural performance (i.e., accuracy) in the 1-Back condition. Lastly, stimulus type predicted skin conductance level and its habituation over time, with lower levels and stronger habituation on the image task. These results indicate that the type of stimulus chosen for an otherwise identical task changes visual sampling strategy and behavioural performance, and was associated with different levels of sympathetic arousal response.

Acknowledgements: Fonds du recherche du Québec – société et culture (FRQSC); Social Sciences and Humanities Research Council of Canada (SSHRC)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

Thank you for your interest in our research and poster. Leon Franzen is walking you through our poster in the video. Please engage with us, send us your feedback, thoughts or anything else that comes to mind to the chat box or leon.franzen@concordia.ca. You can also tweet at Leon @leonfrADC. We are looking forward to hearing from you.

Abstract ID: 626

The role of saliency for visual working memory in complex visual scenes

Poster Presentation - *Topic area: Visual Memory: Space, time, attention*

Martin Constant[1], Heinrich René Liesefeld[1]; [1]LMU Munich

Given its severe capacity limitations, visual working memory (VWM) can process only a tiny fraction of the complex visual world. While selection of relevant information from cluttered scenes is a main topic of research on visual attention, it has not received much research efforts in the VWM community. Based on knowledge from visual-attention research, we developed a task which approaches the complexity of real-world scenes while maintaining tight experimental control over stimulation. Participants were presented with an array of 33 vertical bars and 3 tilted target bars (12°, 28° and 45°). After presentation, one of the targets was probed and participant had to recall its color (continuous report). In a first experiment, we provide evidence that the distribution of a limited VWM resource is parametrically influenced by saliency, $F(2, 18) = 42.77$, $p < .001$. In a second experiment, by assigning the same tilt to targets within a trial, we showed that the distribution of resources is not only influenced by the saliency difference between targets, but also by their absolute saliency. The second experiment also replicated results of the first, $F(2, 60) = 102.90$, $p < .001$. Our third experiment used typical displays (three squares) and demonstrated that – in contrast to the real world – saliency is virtually maxed out for relevant objects in typical laboratory studies of VWM, likely yielding a pronounced underestimation of this major influence on VWM. A fourth experiment examined the influence of saliency across 7 different encoding times and showed that encoding time has an influence on the effect of saliency, $F(12, 180) = 6.72$, $p < .001$, but also that, even after encoding for 2 seconds this effect remains present, $t(15) = 3.52$, $p = .003$, showing that our manipulation of saliency is very strong.

Acknowledgements: This work was supported by the German Research Foundation (DFG) under Grant 2868/3-1 awarded to Heinrich René Liesefeld..

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 8:00 am EDT America/New_York

Presenter's Message

Email: Martin.Constant@psy.lmu.de
More information here: https://linktr.ee/martinconstant

Abstract ID: 499

Visual Search

Effect of Contextual Guidance and Task Difficulty in Exploring Neural Timeline of Visual Search in Natural Scenes

Talk Presentation - *Topic area: Visual Search*

Tiasha Saha Roy[1] (tsr14rs073@iiserkol.ac.in), Arpita Saha Chowdhury[1], Sucheta Chakravarty[2], Koel Das[1];
[1]Indian Institute of Science Education And Research Kolkata, India, [2]University of Alberta, Canada

Contextual information plays a critical role in visual search strategies but its neural timeline and correlates remain poorly understood. This study investigates the neural mechanisms underlying attentional orientation to contextually cued target locations in natural scenes. The primary focus of interest are the target absent scenes, where attention is primarily driven by contextual information rather than target features. 17 human participants performed a visual search task and perceptually decided presence or absence of targets in natural scenes displayed on screen. The targets varied in shape, size and category. Participants reported their response using a 10-point confidence rating and their neural signals were recorded using a 64 channel EEG recording system. From a separate behavioural experiment performed by 20 subjects on the same set of images, the difficulty of the search tasks were evaluated. We used multivariate pattern classifiers to predict coarse contextual locations (left/right) from single trial EEG signals. Our results demonstrate that contextual locations in natural scenes could be predicted reliably from neural activity when observers were searching for targets. Multivariate pattern analysis (MVPA) failed to predict the expected location using the same stimuli in a separate control EEG study when contextual information was made inconsequential. MVPA analysis revealed that the possible location of a target could be predicted more accurately in the easy than difficult search tasks. Finally we demonstrate that for easy targets, contextual facilitation starts as early as 200 ms post stimulus onset whereas for difficult targets, contextual effect was relevant at a later stage alluding to the role of task difficulty in mediating the neural timeline of contextual guidance. Source localization analysis of the event related potential (ERP) suggests that scene information is passed on from Lateral Occipital Complex (LOC) via Intra Parietal Sulcus (IPS) to the fronto-parietal network.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 281

Neural mechanism of priming of popout in visual cortex

Talk Presentation - *Topic area: Visual Search*

Jacob A. Westerberg[1] (jacob.a.westerberg@vanderbilt.edu), Alexander Maier[1], Jeffrey D. Schall[1];
[1]Vanderbilt University

Behavioral priming improves performance in psychophysical tasks. To investigate the neural mechanisms of visual priming, we recorded neural spiking and field potentials across all layers of area V4 in monkeys performing priming of popout visual search. Response accuracy increases and response time decreases with repeated presentation of the same singleton in a search array (e.g., red among green), and performance is impaired when feature assignments change. Neurophysiological substrates of these behavioral changes have been described in the frontal eye field (FEF) (Bichot & Schall 2002 J Neurosci). We investigated whether area V4 contributes to priming of popout. Two monkeys performed a color popout task with sequences of trials organized to elicit consistent priming. Linear microelectrode arrays were introduced into V4 and recorded neural activity across the layers during task performance. Both synaptic activations, measured through current source density (CSD), and neural spiking were measured. We found that priming coincided with earlier target selection measured across all layers of V4 in neural spiking and in the supragranular layers in CSD sinks. The laminar specificity of the changes in target selection time in the CSD suggest that V4 either generates the priming effect or inherits it from higher cortical areas, perhaps FEF, rather than through bottom-up changes in visual processing from earlier visual areas. These results provide new information about the mechanisms of visual memory and provide new constraints on the generation of event-related potential indices of visual attention like the N2pc.

Acknowledgements: P30EY008126, R01EY019882, R01EY027402, R01EY008890, T32EY007135, U54HD083211, Nvidia Corporation, E. Bronson Ingram Chair in Neuroscience

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York
23 June, 11:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 131

Predicting Goal-directed Attention Control Using Inverse Reinforcement Learning and COCO-Search18

Talk Presentation - *Topic area: Visual Search*

Yupei Chen[1], Gregory Zelinsky[1]; [1]Stony Brook University

A great deal is known about goal-directed attention in the context of simple features and hand-crafted stimuli, but far less is known about how attention is directed to cups or chairs or most other common

objects of search. Recent work predicted the fixations made during the search for target-object categories using high-dimensional feature representations learned by deep neural networks, but these networks were trained for object classification, perhaps explaining their modest success in predicting attention control. We adopt the very different approach of learning these control features directly from observations of search behavior. Specifically, we use adversarial inverse-reinforcement learning (IRL), a state-of-the-art imitation-learning method from the machine-learning literature, to learn a reward function for mimicking the gaze fixations made during search. This was not previously possible because there was no search-fixation labeled dataset of images sufficiently large to train a deep network. Here we introduce COCO-Search18, a dataset of 10 participants searching for each of 18 target-object categories (cups, chairs, etc.) in 6202 images. With ~300,000 search fixations, COCO-Search18 is the largest dataset of search behavior currently available. After training and evaluation on COCO-Search18 (70% trainval, 30% test), and recovering the reward maps used for fixation prediction, we found that human and IRL searchers both fixated all 18 target categories well above chance, on average in < 3 saccades (human: 2.62, model: 2.05). We also found that searchers agreed in their assignment of reward to select non-targets/regions when searching for different target categories, meaning that search was guided by features having a spatial or semantic relationship to the target, in addition to target features. The different reward maps learned for different searchers will also be discussed. We show that using IRL and the psychologically-meaningful principle of reward, it is possible to learn the visual features used in goal-directed attention control.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1632

What is the role of working memory in hybrid search?: Evidence from the Contralateral Delay Activity

Talk Presentation - *Topic area: Visual Search*

Lauren Williams[1] (laurenhayleywilliams@gmail.com), Iris Wiegand[2,3], Mark Lavelle[1], Jeremy Wolfe[2], Keisuke Fukuda[4], Trafton Drew[1]; [1]University of Utah, [2]Brigham and Womens Hospital, Harvard University, [3]Max Planck UCL Centre for Computational Psychiatry and Ageing Research, [4]University of Toronto Mississauga

In “Hybrid Search”, observers search for any member of a set of targets held in memory. Current hybrid search models propose working memory (WM) serves to pass representations of attended items one at a time from early visual processes into long-term memory (LTM) for comparison to target representations

(Drew, et al., 2015). Here, we sought to better understand the role of WM in hybrid search using an ERP component associated with WM load, the Contralateral Delay Activity (CDA). Participants (N=20) memorized setsizes (MSS) of 2 or 16 categorical targets (dogs, cats, tables, or dressers), counterbalanced across participants. Next, they passed a recognition memory test twice with >=80% accuracy. Then, for 700 trials (per MSS), participants were cued to attend to one lateralized search item and indicate if a target was present. The cued object was either a target (e.g., target cat), a non-target from the target category (e.g., non-target cat), a non-target from a similar category (e.g., dog), or a non-target from a dissimilar category (e.g., table). ERP waveforms were time-locked to search onset. Overall, CDA amplitude was larger for objects from the target category, which provides support for the idea that processing is terminated for irrelevant objects following initial object identification (Cunningham & Wolfe, 2014). For objects within the target category, CDA amplitude increased with MSS, suggesting LTM load-dependent WM involvement in hybrid search. Furthermore, N2pc amplitude increased as the non-targets became more similar to the object category, but only for MSS16. This suggests more non-targets with similar features were selected for further processing in memory at larger MSS. Together, these findings demonstrate WM plays a larger role in hybrid search than previously thought. Specifically, to identify objects within the target category, WM resources may be deployed to compare the target set held in LTM to the potential target.

Acknowledgements: The National Science Foundation Graduate Research Fellowship Program (Grant #1747505) awarded to LW. Binational Science Foundation (Grant #2015301) awarded to TD.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Thanks for your interest in this research!

If you have questions/comments, please feel free to reach out to me through the VSS chat, on Twitter (@LWilliamsPsych), or via email at laurenhayleywilliams@gmail.com.

Youtube Link to Video: https://youtu.be/j7MxXNxszeI

Abstract ID: 261

What you don’t see can help you: Image triage in human-AI interactions

Talk Presentation - *Topic area: Visual Search*

Chia-Chien Wu[1] (cchienwu@gmail.com), Leah Kumle[2], Makaela Nartker[3], Jeremy Wolfe[1]; [1]Harvard Medical School; Brigham and Women's Hospital, [2]Goethe University Frankfurt, [3]Johns Hopkins University

The performance of artificial intelligence (AI) has reached expert levels for several medical image screening tasks. Nevertheless, in clinical settings, the combination of AI and expert radiologists often fails to produce better outcomes than either working alone. We gave non-expert observers simulated AI assistance to search for target textures in arrays of eight color textures located on a virtual circle. Target colors were drawn from a distribution that differed by 2.2 standard deviations from the distractor distribution. Four conditions were tested: 1) “On-demand AI” gave a probability that specific items were targets only when asked by the observer. 2) “Image triage” used a liberal criterion to filter the images that were shown to the observer. If AI was “sure” that an item was not a target, it was not shown, reducing the set size. If AI eliminated all items, the entire trial was not shown. 3) “Both”: First, images were triaged. Observers could then query remaining stimuli for the probabilities that they were targets. 4) “Control” condition had no simulated AI. Prevalence was 50% or 10% in different blocks. Results: Triage improved performance. On-demand AI did not. Prevalence did not change this pattern, though miss errors were elevated at low prevalence. In Experiment 2, On-demand was replaced by a “Second Reader” AI that gave its opinion after humans’ response and allowed humans to change their previous response. Again, Triage helped. Second Reader AI did not. Unlike Wolfe and Nartker’s (VSS2019) results, using Both (AI for triage and second reader) was not better than Triage alone, perhaps because the Second Reader was not effective in this paradigm. Similar results were obtained at low prevalence. In search tasks, Image Triage, where AI saves time by eliminating some stimuli, may be more promising than methods where AI tries to offer positive advice.

Acknowledgements: NIH EY017001, CA207490

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 9:00 am EDT America/New_York

Presenter's Message

Thank you for your interest! Email me if you have any questions (cchienwu@gmail.com)

Abstract ID: 519

Why are target absent searches so systematic?

Talk Presentation - *Topic area: Visual Search*

Georgin Jacob[1,2] (georginjacob@gmail.com), Divya Gulati[2], Pramod RT[1,2], SP Arun[2,1]; [1]Electrical Communication Department, Indian Institue of Science, [2]Centre for Neuroscience, Indian Institute of Science

We all know that finding a target is easy if the distractors are dissimilar. But what about when there is no target? Do target-absent responses vary systematically too? Surprisingly there have not been any attempts to answer this question. Here we set out to investigate this question using a combination of behavioral experiments in humans and recordings of single neurons in monkey inferior temporal cortex. In Experiment 1, subjects had to view a search array and indicate whether any oddball target is present or absent. Target absent times were highly systematic, as evidenced by a strong split-half correlation across subjects ($r = 0.75$, $p < 0.0005$). We hypothesized that the target-absent search time might depend on how distinctive an object is compared to other objects. We measured the pairwise dissimilarity between all pairs of images in Experiment 2. For each object, we measured its distinctiveness as its average distance from all other objects in the experiment. This quantity, derived from target-present search times, was strongly predictive of the target-absent search time ($r = -0.77$, $p < 0.0005$). In Experiment 3, we showed that target-absent search times are independent of context, suggesting that they are driven by a universal rather than a context-dependent computation. Finally, we wondered how distinctiveness might be calculated in the brain, since it is unlikely that the neural response to a given (viewed) object can be compared with the response to many other objects not currently visible. To address this issue, we asked whether distinctiveness can be predicted by the activity of a population of neurons responding to a single object. Indeed, a weighted absolute difference computation was strongly predictive of distinctiveness. Taken together our results highlight a universal variance computation on objects, which we call distinctiveness, that systematically predicts absent-search times.

Acknowledgements: This research was funded through a Senior Fellowship from the DBT-Wellcome India Alliance (Grant # IA/S/17/1/503081) and the DBT-IISc partnership programme (both to SPA).

This talk will be presented in Live Talk Session 6, Tuesday, 23 June, 7:00 am EDT America/New_York.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1742

Visual Search: Attention

Aging affects attentional window and perception in the periphery

Poster Presentation - *Topic area: Visual Search: Attention*

Julie Ouerfelli-Ethier[1,2], Noemie Redureau[1], Laure Pisella[2], Aarlenne Z. Khan[1]; [1]University of Montreal, [2]ImpAct, INSERM UM1028, CNRS UMR 5292, University Claude Bernard Lyon 1

Aging has been associated with decline in perceptual and cognitive functions, but the findings remain inconclusive. Here we tested how attentional window, i.e. how widely we can distribute our attention around a certain fixation location when searching for an item among distractors, changes with aging. Specifically, we investigated whether aging resulted in a decrease in attentional window during easy or parallel visual search (global processing). We also tested whether performance in visual search was related to perceptual visual function with a contrast detection task and two motion tasks (local and global motion perception) at two different eccentricities (5° and 10° eccentricity). We measured the size of the attentional window using different sized gaze-contingent visible windows in 12 younger adults and 11 older adults during a pop-out visual search task. Older adults showed a significantly smaller attentional window (M = 19.4°, SD = 3.3°) compared to younger adults (M = 23.1°, SD = 2.3°). They also had significantly higher contrast detection thresholds (M older = 9.3%, SD older = 5.1%; M younger = 4.9%, SD younger = 3.1%) and needed longer presentation times to estimate global motion (M older = 442.8 ms, SD older = 221.2 ms; M younger = 177.8 ms, SD younger = 70.4 ms). In contrast, we found no difference in local motion perception thresholds between groups. Taken together, our results suggest that both attentional and perceptual deficits may explain impaired visual function in older adults.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 298

Developing an OATS (Operationalized Attentional Task Set): Assessing how attentional sets update with task experience

Poster Presentation - *Topic area: Visual Search: Attention*

Ryan E. O'Donnell[1] (ryanodonnell7@gmail.com), Brad Wyble[1]; [1]Pennsylvania State University

When participants receive instructions to perform a task, they create an attentional set. This set can then update while performing the task as participants learn how to efficiently complete it. We term this modified set an operationalized attentional task set (OATS) and measure its development through speeded visual search tasks. Participants were instructed to search for categorically-defined targets (“Letters”) and report their location. However, only a subset of category members were presented as targets frequently across trials. After presenting multiple instances of each frequent target, novel targets were sporadically shown to assess whether RT to novel targets was slower compared to frequent targets, suggesting that an OATS developed to shift focus from the categorical target definition to an item-specific one. Experiment 1 demonstrated this novelty slowing, but only with 4-letter target subsets. Using 12-letter target subsets, novel RT was not slower, implying that the attentional set remained categorical rather than item-specific. However, Experiment 2 provided evidence that increasing the number of frequent target presentations for 12-letter target subsets formed an item-specific OATS. Experiment 3 utilized a semantic target category (“Animals”) and demonstrated that an OATS can form to focus on a semantically compact (“Birds”) or diversified (“Non-mammals”) set of frequent targets, but not as strongly when diversified. Finally, Experiment 4 tested a prediction that targets not included in one’s OATS would require increased processing to be selected, leading to improved performance on an unexpected memory test. An unspeeded surprise trial paradigm revealed better identity memory for targets not in an item-specific OATS, supporting this prediction. Overall, our results demonstrate the formation of an OATS that can differ from the instructional set. Moreover, we hypothesize that the two attentional sets exist concurrently, with an OATS (selecting frequent targets) overlaying the slower instructional task set (responding to novel targets), improving task efficiency.

Acknowledgements: This work was funded by BSF Grant 2015299

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

I apologize for not being able to upload a video walkthrough of my poster, but I am happy to answer any and all questions you may have regarding this work! Feel free to use the chat room in V-VSS or email me at reo138@psu.edu for any questions or comments you may have!

Abstract ID: 1482

Got Your Attention! – Threatening Targets Result in Longer Reaction Times

Poster Presentation - *Topic area: Visual Search: Attention*

Kaitlin Erpenbeck[1], Joanna Lewis[1]; [1]University of Northern Colorado

Visual search literature supports the notion that threatening stimuli capture attention, as threatening distractors lead to longer reactions times (RTs) in comparison to searches where no threat distractors are present (Devue, Belopolsky, Theeuwes, 2011; Hansen & Hansen, 1988). This is potentially due to the evolutionary advantage of noticing threats even when focusing on a task not explicitly involving said threats (Öhman, 2009). Shorter RTs were expected for visual searches with threatening targets, as attention capture should lead to faster target localization. We compared trials in which the threat was a target, a distractor, and absent, following the Irrelevant Singleton Paradigm (Theeuwes, 1991, 1992, 1994). Participants completed a search task (set sizes: 4 or 8 items) and reported on target directionality. The target was a color singleton (red stimuli amongst black distractor objects), which was independent of its status as a butterfly (non-threat stimulus) or a spider (threat stimulus), and the target was a threat stimulus at chance (1/set size). Low-level visual properties were controlled for in both stimuli sets by utilizing vector images (i.e., contrast and color were consistent). Experiment 1 had threats as the target or distractor; Experiment 2 had threat-target, threat-distractor, and threat-absent trials. The task and stimuli remained consistent. The current results were unanticipated, as participants took longer to complete the task in threat-target trials in comparison to threat-absent and threat-distractor trials. Previous literature has suggested that attention is ultimately still captured by threat stimuli, but that the following disengagement of attention may be delayed. Attention might be quickly captured but slowly released for threating targets in comparison to non-threating targets, indicating interference with task completion (Fox, Russo, & Dutton, 2002; Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2004). We are currently examining if these costs are associated with overt attention shifts displayed by oculomotor capture.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1499

Investigating the costs of interruptions on visual search performance

Poster Presentation - *Topic area: Visual Search: Attention*

David Alonso[1] (davidalonsoq53@gmail.com), Aydin Tasevac[1], Lauren Williams[1], Trafton Drew[1]; [1]University of Utah

Interruptions are a common occurrence in our daily life. Previous research has shown that interruptions negatively impact human performance (Froughi et al., 2014; Nicholas & Cohen, 2016). However, research

on the impact of interruptions during visual search is sparse. In three experiments, we examined how interruptions affect performance on visual search tasks and whether interruption cost is modulated by task difficulty. Participants counted the number of Landolt C targets of a specific orientation in a display of 150 items. After search, participants reported the number of targets they identified. Throughout the experiments, search was interrupted on certain trials by a set of math problems. In Experiment One, working memory load was varied during search by asking participants to count targets in one or three separate colors. In Experiment Two, WM load was held constant and the interruption task was either easy math problems (single digit) or hard math problems (double digit). In both experiments, response times (RT) were significantly longer during interrupted trials. Contrary to previous research in other domains, there were no accuracy costs for interrupted trials in either experiment. The effect of interruption on RT was not modulated by the difficulty of the search task or the interruptions. In Experiment Three, we investigated whether these results might be due to a speed-accuracy tradeoff by placing a 30-minute limit on task completion time. Thus, participants were discouraged from spending extra time on interrupted trials in order to avoid making mistakes. However, Experiment Three showed the same pattern of results observed in prior experiments. Overall, these results suggest interruptions lead to a general time cost during visual search, which cannot be explained by a speed-accuracy tradeoff.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

If you have questions or want to talk about the experiments please email me at davidalonsoq53@gmail.com.

I am also happy to setup a zoom meeting with anyone who is super interested.

Abstract ID: 772

New attentional templates interfere with the retrieval of existing attentional templates

Poster Presentation - *Topic area: Visual Search: Attention*

Stanislas Huynh Cong[1] (stanislas.huynhcong@unige.ch), Dirk Kerzel[1]; [1]Faculty of Psychology and Educational Sciences, University of Geneva

Attentional templates are representations of target features in Visual Working Memory (VWM). Previous research has established that simultaneous guidance of visual search by two attentional templates is possible, but the determinants of each template's efficiency are poorly understood. Recently, Berggren,

Nako, and Eimer (2019) compared the latencies of RTs and N2pc components to transient and sustained templates. Two target colors were cued before the search display onset. In blocked trials with transient targets, both colors changed on every trial. In blocked trials with sustained targets, both colors were fixed throughout. In the mixed condition, one color was fixed while the other changed from trial to trial. Using a similar design, we replicated faster RTs to transient than sustained targets in the mixed condition and no difference in the blocked conditions. In a second experiment, subjects reproduced one of the two target colors on a color wheel after each search episode. The concomitant memory task reduced the difference between sustained and transient targets in the mixed condition, indicating that keeping both targets in memory for later recall decreased competitive interactions between them. Further, analysis of color judgments showed that random guesses of sustained targets increased in the mixed compared to the blocked condition, whereas random guesses for transient targets did not differ. These findings suggest that the transfer of the sustained template from long-term memory to VWM exposes it to competitive interactions with transient search goals. Moreover, manipulations of the time interval between the cue and search display did not modulate the difference between sustained and transient targets in the mixed condition, corroborating the idea that the phenomenon depends on the retrieval of the sustained template at search onset. Accordingly, when advancing retrieval with a retro-cue, sustained and transient templates became equally efficient in the mixed condition.

Acknowledgements: This work was supported by grant 100019_182146 from the Swiss National Science Foundation (SNSF), CH.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

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Even if I did not schedule any video conferences on Zoom for this presentation, I'd be happy to answer all your questions in the dedicated chat. I will answer them when I log on to this page, that is, every day during the entire event. In addition, feel free to send me an email (Stanislas.HuynhCong@unige.ch) if you need further precision.

Stanislas Huynh Cong
https://www.researchgate.net/profile/Stanislas_Huynh_Cong

Huynh Cong, S., & Kerzel, D. (in press). New templates interfere with existing templates depending on their respective priority in visual working memory. Journal of Experimental Psychology: Human Perception and Performance

Abstract ID: 361

Repeated search can make search slower and less efficient.

Poster Presentation - *Topic area: Visual Search: Attention*

Steven Pesina[1] (steven_pesina@mymail.eku.edu), D. Alexander Varakin[1]; [1]Eastern Kentucky University

Phenomena such as contextual cuing demonstrate that memory can facilitate visual search. In contextual cuing, observers search repeatedly through the same configurations, and as long as the relationship between target (e.g. rotated T) and distractor (e.g. rotated L's) locations remains stable, search becomes faster and more efficient (Conci & Müller, 2012, Visual Cognition). However, sometimes visual search proceeds without relying on memory. For example, in Wolfe, Klempen, and Dahlen (2000, JEP: HPP), observers repeatedly searched the same displays hundreds of times. Despite ample opportunity to become familiar with each display, visual search did not become faster or more efficient. The current experiment used a repeated search paradigm to test if observers could use knowledge of where targets had appeared in previous trials in order to facilitate search. Participants' task was to search for a rotated T amongst rotated L's (set sizes of 8, 12 and 16). The same configuration was searched 8 times consecutively, and within a repetition series, the target never appeared in the same location, but appeared in a unique location on each trial. Participants were told that configurations would repeat for 8 consecutive trials, and that target location would not. The results showed a significant decrease in the efficiency (slope increased from 37 ms/item on the first repetition to about 50 ms/item on the eighth) and an increase in response time as configurations repeated. In this case, memory for past searches seems to have interfered with search. This result may be explained by the idea that locations that were once occupied by distractors are inhibited from one trial to the next.

Acknowledgements: SP was supported by the McNair Scholars Program

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Contact Me:
sape255@uky.edu

Abstract ID: 637

Utilization of negative attentional template in search mediated by task difficulty

Poster Presentation - *Topic area: Visual Search: Attention*

Renee Sahatdjian[1] (rms218@lehigh.edu), Nancy Carlisle[2], Ziyao Zhang[3]; [1]Lehigh University

A predominant finding in attentional literature is that the presentation of a target (positive) cue can bias attention towards the target, and lead to significant benefits in search performance. Yet, it has been largely debated whether negative cues, indicating distractor color, enhance search performance by guiding attention away from distractor items . Recently, a study examined whether task difficulty, manipulated by varying the levels of distractor and target similarity, could play a role in whether negative search templates are effective (Conci, Deichsel, Müller, & Töllner, Visual Cognition, 2019). In a between-subjects design, they found that negative search templates provided significant benefits to search performance, but only during the more difficult tasks, suggesting participants adopted different strategies for easy versus hard visual search when presented with a negative cue. In this study, we wanted to know if these strategy switches could happen within subjects as well. Participants searched for a target T shape among a series of distractors. On easy trials, targets and distractors were distinct and on hard trials target and distractor shapes were more similar. Preceding the search task, a color cue was presented, and participants were informed that the color presented would either match the color of the target (positive cue), match the color the participant was to ignore (negative cue), or it would not match any color in the search task (neutral cue). Replicating the pattern from Conci and colleagues (2019), there was no benefit to using the negative cue on easy trials, but a significant benefit to search on hard trials. This suggests participants can easily switch between using the negative cue and ignoring it based on task difficulty, and emphasizes that negative cue use is a strategic choice.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 385

Visible persistence plays an important role in the preview effect

Poster Presentation - *Topic area: Visual Search: Attention*

Xin Keyun[1] (11839013@zju.edu.cn), Zheng Yujie[1], Li Zhi[1]; [1]Zhejiang University

Visual search is more efficient when a subset of distractors is presented before the display containing the remaining distractors and a target. This benefit is known as the ‘preview effect’. It has been shown that whereas the preview effect disappeared in a brief preview (e.g., 150 ms) condition, it could be restored simply by showing the same items of the previewed distractors about half a second earlier before that brief preview condition, which suggested preview effect may be due to the inhibition of previewed distractors maintained in visual working memory. However, in the present study, we discovered the presence of preview benefit was strongly correlated to the availability of the visible persistence (rather than working memory) of those previewed distractors. In a ‘one-time top-up’ condition, the earlier exposure of the previewed distractors was presented once (2100 ms before the brief preview and lasted 450 ms). In a ‘repeated top-up’ condition, the earlier exposure of the previewed distractors was repeated three times (2100 ms before the brief preview; lasted 450 ms and followed by a 250 ms blank period in each repeat). A clear preview effect was present in the ‘repeated top-up’ condition, but no preview effect was present in the ‘one-time top-up’ condition. In fact, in the ‘repeated top-up’ condition, the visible persistence of the previewed distractors was strongly shortened as demonstrated in a missing-dot paradigm, whereas the 2100 ms earlier exposure was sufficient for establishing a working memory representation of the previewed distractors. Therefore, the present findings suggested that the visible persistence rather than working memory might be the main underlying mechanism of the preview effect.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 370

Visual Search: Context

An early locus of contextual cueing: An investigation with the speed-accuracy tradeoff task

Poster Presentation - *Topic area: Visual Search: Context*

Honami Kobayashi[1] (esf09334@kwansei.ac.jp), Hirokazu Ogawa[1]; [1]Kwansei Gakuin University

Visual search is expedited in a repeatedly encountered spatial context. A much-debated question is whether attentional guidance in visual search is facilitated by contextual cueing, and if so, how early this facilitation arises. The current study investigated the facilitation of attentional guidance by examining the

time course of contextual cueing benefits. The participants in an experiment engaged in an SAT (speed-accuracy tradeoff) task after learning the spatial contexts in a standard visual search task in which they searched for a rotated T target among Ls. In the SAT task, participants were required to search for a target and respond immediately when a sound probe was presented, even if they had not found or identified the target. The inter-stimulus interval between a search display and the probe varied from 40 ms to 2,000 ms. Participants completed two blocks of the SAT task, in which they searched either under "learned" or "new" contexts. The result of the SAT procedure indicated that responses were more accurate in repeated contexts than in new contexts, even when only a brief time had elapsed after the search display presentation (>90 ms). We also conducted an analysis of the time course of contextual cueing effect using Bayesian hierarchical modeling. Our model was based on the conventional SAT function that describes the increase of accuracy as a function of elapsed time after stimulus presentation. This analysis demonstrated that the rate of accuracy increase was higher than in new contexts than in repeated contexts. These findings suggest that attentional guidance is enhanced by learning the context, and this enhancement begins at a very early stage of the visual search.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 1:00 am EDT America/New_York
22 June, 11:00 pm EDT America/New_York

Presenter's Message

For further information and the html version of the poster, visit: https://honamik-s.github.io/vss2020/. Enter the password vss2020hk to view the page.

Abstract ID: 958

Contextual cueing in preview search

Poster Presentation - *Topic area: Visual Search: Context*

Yi Ni Toh[1] (tohxx011@umn.edu), Caitlin A. Sisk[1], Yuhong V. Jiang[1]; [1]University of Minnesota

Because serial search involves focal attention, components of a visual search array that are not actively searched may be poorly remembered and learned. However, statistical learning mechanisms may still encode aspects of an array that observers do not actively search. Here, using contextual cueing and a preview search paradigm (Hodsoll & Humphreys, 2005), we investigated the degree to which implicit learning of repeated visual search context depends on active search. On each trial of a visual search task, half of the distractors appeared 800 ms before the addition of the other distractors and the target. Previewing a subset of distractors that never contained the target should limit search largely among the newly added set that always contained the target. Unbeknownst to the participants, across multiple blocks,

we repeated either the locations of the previewed distractors, the new locations of the newly added items, both, or neither. Unlike a previous finding (Hodsoll & Humphreys, 2005), repeating the newly added set facilitated search, reaffirming the presence of contextual cueing in attended and actively searched contexts. In addition and in line with those previous findings, repeating the previewed context also facilitated search, even though the previewed context was not actively searched. In fact, the effect size of contextual cueing was greater when the previewed set repeated than when the actively searched set repeated. These data demonstrate that although active search can induce learning, it is not the only factor driving contextual cueing. Temporally leading context may also be learned even when not actively searched. These findings are inconsistent with theories of contextual cueing that place learning at the level of oculomotor or attentional scan path. Furthermore, the finding shows that long-term selection history effects, exemplified by contextual cueing, interact with short-term selection history effects.

Acknowledgements: CAS was supported by an NSF fellowship.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1259

Different target identities enable people to find a new target faster even in learned contexts

Poster Presentation - *Topic area: Visual Search: Context*

Jeunghwan Choi[1] (abcdef0518@naver.com), Sang Chul Chong[1,2]; [1]Graduate Program in Cognitive Science, Yonsei University, [2]Department of Psychology, Yonsei University

People find targets faster in repeated contexts than in novel ones (contextual cueing; Chun & Jiang, 1998). It is well known that contextual information guides attention to the target location. In addition, some studies found that it is difficult to adapt to the change of a target location in learned contexts (Manginelli & Pollmann, 2009; Zellin et al., 2014). However, the identity of the target was the same throughout experiments in their studies. We investigated whether the change in target identity enables people to learn new contextual information about a new target location in learned contexts as well as initial learning. To change the identity of a target, we used real-object images as stimuli. The task was to click the target object among 16 objects in the array using a mouse. There were two phases in Experiment, and the target identity differed across phases. At the beginning of Experiment, participants were informed the identity of a first

target and the possibility of a target identity change after the first phase. The identity of a new target for the second phase was announced after the first phase. Contexts were either repeated or newly generated. Specifically, the locations of distractors in the repeated contexts were maintained throughout Experiment, whereas in the novel contexts they were randomly changed for each trial. We found significant contextual cueing effects in both the first target and second target phases. Furthermore, the size of these effects and their speed of learning was similar between the two phases. These results suggest that people can learn and use the new contextual information even in the learned contexts without interference, when the identity of the target was changed. Thus, different target identities enable people to form two separate associations with the two locations of different targets for a given context.

Acknowledgements: This research was supported by the Brain Research Program of the National Research Foundation (NRF) funded by the Korean government (MSIT) (NRF-2017M3C7A1029658).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1709

Visual Search: Expectation, memory, representation

An endogenous invalid cue degrades the inhibitory template for visual marking

Poster Presentation - *Topic area: Visual Search: Expectation, memory, representation*

Kenji Yamauchi[1,2] (kjyamci601@gmail.com), Jun Kawahara[1]; [1]Hokkaido University, [2]Japan Society for the Promotion of Science

Visual marking, which is based on the assumption that previewing some distractors increases the efficiency of subsequent visual searches, constitutes one of the efficient inhibitions on visual searches. The preview search task consists of a display of a subset of distractors followed by an additional display containing the remaining distractors and a target. During the preview period, an inhibitory template is thought to be formed, resulting in the prioritization of the subsequently presented items and the inhibition of the previewed items. Previous studies have demonstrated the determinants that impair the inhibitory templates resulting in inefficient visual searches when any events consuming attentional resources

occurred simultaneously with the onset of additional items. In the present study, we examined whether the inhibitory template would be influenced by another event before the onset of additional items. To this end, we used a cuing paradigm. Under the cue condition, we changed the fixation cross into an endogenous cue (i.e., a right or left arrow) during the preview period. The cueing validity was 75%. The results were that compared with the no-cue control condition, the invalid cue worsened the search performance, though the valid cue lead to the equivalent search performance. These results indicated that an invalid cue degraded the inhibitory template. It might be because attentional resources to maintain the template was depleted during attentional disengagement from the cued space and attentional shift to the opposite space to the cued location. Therefore, the event even before the onset of additional items could influence the inhibitory template only when a visual event could deplete attentional resources afterward.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 972

Investigating N2pc effects with the use of Prior Knowledge and Novel Information in Visual Search

Poster Presentation - *Topic area: Visual Search: Expectation, memory, representation*

Austin Moon[1] (smoon041@ucr.edu), Christine Dang[1], Genesis Hester[1], Leighanne Durrett[1], Alex Duong[1], Leah Ferguson[1], Megan Peters[2], Rachel Wu[1]; [1]University of California, Riverside-Department of Psychology, [2]University of California, Riverside-Department of Bioengineering

Previous research has shown that visual search efficiency is affected when using prior knowledge (e.g., looking for semantically-related objects; Wu et al., 2013, see also Telling et al., 2009) and novel information (e.g., using patterned sequences vs. random sequences to guide attention; Zhao et al., 2013). How might the use of prior knowledge and novel information impact search efficiency when both can be utilized during search? Across two experiments, this study used a visual search paradigm (2-item search array) with known real-life objects (food vs. toys) and statistical patterns with novel rune symbols as proxies for prior knowledge and novel information, respectively. Rune patterns were presented in either structured or random sequences in the locations of upcoming target and distractor objects in the search array. Experiment 1 (behavioral study, n=31) found that participants were marginally faster at detecting items in patterned locations, compared to random locations (replicating Zhao et al., 2013). However, this effect was not present when distractors that were semantically related to the target appeared (i.e., no interaction

between use of prior knowledge and novel information). Experiment 2 (ERP with behavioral measures, n=12) revealed that the behavioral results largely replicated those from Experiment 1. Interestingly, the N2pc ERP component (marker of target selection) was twice as large when targets were in the random location, compared to when the targets were in the pattern location, which is the opposite pattern of the behavioral results. Although this N2pc amplitude difference was not statistically significant (p=.287) with 12 participants, data collection is ongoing until the pre-registered number of 20 participants. These results suggest that novel sequences may impact behavior and neural responses to search tasks differently, and in some cases may not interact with prior knowledge.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1277

Not so simple at all? Reluctance to switch between single-feature search targets in visual foraging

Poster Presentation - *Topic area: Visual Search: Expectation, memory, representation*

Jan Tünnermann[1] (jan.tuennermann@uni-marburg.de), Anna Schubö[1]; [1]Phillips University Marburg

Visual foraging paradigms, in which observers search and collect multiple elements from different target classes, have provided insight into attention guidance and the maintenance of search templates. One particularly striking effect is the reluctance of human participants and other biological organisms to switch between different but equally valuable target types. Earlier research showed that instead of frequent switching, foragers collect one particular type in longer runs, especially when targets were defined by conjunctions of multiple features. Here, we show that the switching frequency is also modulated by relationships within a single feature dimension. In two experiments, we found that switching between differently colored but otherwise similar targets depended on the color space distance between the two targets and the distractors' color space position relative to the targets. The strongest reduction of target switching---almost matching that of conjunction targets---occurred when the distractor colors were located between two relatively close target colors. Our findings challenge current views that run-like foraging is only related to difficulties in activating more than one complex (e. g. conjunction) template at the same time. Depending on the relationships and distances between target and distractor features within a single dimension, template activation switches or updating of attentional control settings seem to be impaired as well, benefiting strategies that stay with one target type for longer runs.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1186

Visual Search: Features, scenes

A theory of visual search for targets added to natural backgrounds.

Poster Presentation - *Topic area: Visual Search: Features, scenes*

R. Calen Walshe[1] (calen.walshe@gmail.com), Jared Abrams[1], Wilson Geisler[1]; [1]Center for Perceptual Systems, The University of Texas at Austin, [2]Department of Psychology, The University of Texas at Austin

Due to the fact that objects of interest may be located at many possible locations in the environment, the capacity to efficiently visually search the environment for those objects is an essential visual capacity. The foveated nature of the human visual system requires that humans make fixations in rapid succession to locate targets. In this work, we develop a theory of foveated search for natural images and test the theory on simpler white noise backgrounds. The core of the theory takes advantage of recent work showing that suitably normalized template matching observers detecting targets with position known exactly are approximately optimal for detection in a wide variety of natural background conditions, and that they are consistent with human detection performance. In particular, detectability of targets has been shown to be proportional to a separable product of four factors: the background luminance, contrast, target similarity and partial masking of targets by local contrast. The background masking factors are combined with a foveation factor - detectability is inversely proportional to ganglion cell spacing - to produce detectability maps that are accurate for natural images. For search tasks, the detectability maps can be combined with incoming sensory information and a prior distribution over potential target positions to compute a posterior distribution of target presence at each location in the image. The posterior distribution is then used to select an action such as responding with the target location, responding target absent, or selecting a new fixation location. We tested the theory in white noise backgrounds in a relatively simpler covert search task. Human error rates averaged over spatial location correspond to the theoretical predictions. However, humans make a higher proportion of errors near the fovea, possibly due to underestimation of priors near the fovea or to allocating more decoding resources to the periphery.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 404

Are target representations affected by search prevalence rates?

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Michael Miuccio[1] (michael.miuccio@ucf.edu), Cianna Piercey[2], Joseph Schmidt[3]; [1]University of Central Florida

Low-prevalence search targets are missed disproportionately more often than high-prevalence targets (Wolfe et al., 2005). Such errors have been attributed to multiple sources, including shifting decision criterion (Wolfe, et al., 2010), target recognition errors (Godwin, et al., 2014; Schwark et al., 2013), and motor response errors (Fleck & Mitroff, 2007; Rich et al., 2008). However, recent findings indicate that the mental representation of the target has a substantial impact on later search performance (Schmidt, et al., 2014). Furthermore, when a difficult search is expected, a more detailed target representation is maintained in visual working memory (VWM; Schmidt & Zelinsky, 2017). In the current study, we examined whether the increased difficulty associated with a low-prevalence search affects the VWM representation of a target, as measured by contralateral delay activity (CDA). Participants were cued with a pictorial preview of two different target stimuli (200 ms), drawn from 18 potential real-world object target categories. CDA was assessed in the delay period after preview offset (1000 ms) but prior to search. Targets and distractors consisted of 22 real-world objects evenly drawn from the previewed categories. Target prevalence was blocked with order counter-balanced across observers. High-prevalence search consisted of 90% target present trials and low-prevalence search consisted of 10% target present trials. Consistent with previous reports, preliminary results suggest that target detection accuracy decreased in low-prevalence (42%) relative to high-prevalence search (79%). Interestingly, preliminary results also indicate that low-prevalence target-related CDA (M = -0.79) may be larger than high-prevalence target-related CDA (M = -0.39). These early findings suggest that the expectation of a difficult low-prevalence search results in more target details extracted from the preview. This raises the intriguing possibility that some low-prevalence misses could be avoided by optimizing the target representation.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 836

Background complexity decreases evidence accumulation rates during parallel processing in efficient search

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Gavin Ng[1] (gavin.jp.ng@gmail.com), Kirk Ballew[2], Alejandro Lleras[3], Simona Buetti[4]; [1]University of Illinois

Parallel processing in efficient search tasks involves a rejection of non-target items via a process of evidence accumulation. This evidence accumulation process results in a logarithmic increase in response times as a function of set size. The slope of this logarithmic function indexes the rate of accumulation; the greater the target-item similarity, the slower the rate, the steeper the slope. Although almost all of visual search in the real world involves items against backgrounds, evidence accumulation thus far has only been examined without backgrounds. Here, we examined the effect of background information in efficient search tasks. In Experiment 1, search stimuli were displayed against a background that was either a scene, phase-scrambled, or solid-colored. When target-distractor similarity was low, there was no effect of background type on both the slope and intercept of the logarithmic function. When target- distractor similarity was high, the slope for the scene background was steeper than that for the scrambled background, which was in turn steeper than that for the single-colored background. Thus, the greater the complexity of the background, the slower the rate of evidence accumulation of individual items. In Experiment 2, we examined the effect of meaningful but unstructured backgrounds by replacing the solid-colored background with an upside-down scene. Regardless of target-distractor similarity, the upside-down background produced the shallowest slope (fastest accumulation rate) and the highest intercept. Consistent with previous findings, our results suggest that processing of scene gist is automatic. When the scene is meaningful but unstructured, a constant processing cost (increased intercept) is incurred. This could arise either from the discounting of the inconsistent background, or a longer time to obtain scene gist. However, object segmentation is easier since objects do not blend in with the upside-down scene structure, resulting in a faster accumulation rate.

Acknowledgements: This material is based upon work supported by the National Science Foundation under Grant No BCS1921735.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 460

Directional Cueing Explains Search Time Advantage for Interacting Dyads

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Tim Vestner[1] (tim.vestner@gmail.com), Katie Gray[2], Richard Cook[1]; [1]Birkbeck, University of London, London, UK, [2]University of Reading, Reading, UK

An increasing number of studies have investigated the visual perception of social interactions. A commonly used paradigm in this research is the comparison of facing and non-facing dyads in visual search, where facing dyads are found faster than non-facing dyads. This has commonly been interpreted as evidence of a specialized system for social interaction processing. In a series of experiments (N=40 each), we use this same paradigm to first replicate previous findings and then show that similar effects can be found when presenting non-social pairs of arrows. We then exclude the possibility of different causes producing these similar results by using combined face-arrow pairs, which again produced a response time advantage for pairs that directionally cue each other. These findings indicate that the search advantage found for facing dyads is a product of the directional cues present within these arrangements, not the fact that they are processed as social interactions per se. This highlights the need for existing paradigms used in this area of research to be further refined as this common manipulation not only changes the perception of social interaction but also how participants attend to these displays.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1158

How texture and shape distinctiveness combine in the visual system to guide attention.

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Zoe Jing Xu[1], Alejandro Lleras[1], Simona Buetti[1]; [1]University of Illinois, Urbana Champaign

Buetti, Xu and Lleras (in press) measured RTs when participants searched for a target that differed from distractors along a single feature, either color or shape (unidimensional search) and used it to predict RTs when targets differed from distractors along both color and shape (bidimensional search). Three models were compared: the Best Guidance model (the most distinctive feature determines performance), the Orthogonal Combination model (features are integral, Euclidian metric), and the Collinear Combination model (features are separable, city-block metric). The results favored the Collinear Combination model, indicating that shape and color are separable features and thus the visual distinctiveness along each dimension combined linearly to produce the overall distinctiveness of a target defined by color and shape. Here we present a new set of experiments studying combinations of two different feature dimensions. In Experiments 1-5, we explored how unidimensional search for texture (Experiment 1) and shape (Experiment 2) combine to determine the distinctiveness of the target when it differed from distractors along both texture and shape (Experiments 3-5). We predicted RTs in each of the 12 conditions that were run in each experiment (4 set sizes x 3 different distractor types), for a total of 36 separate predictions across three new groups of subjects. Results showed that the orthogonal combination model gave the best prediction (R^2= 90%, with a mean prediction error of 14 ms, with a prediction range of 190ms), indicating that texture and shape are integral features and the distinctiveness along these single dimensions combine with a Euclidian metric to determine the overall bidimensional distinctiveness. Furthermore, there was evidence these two dimensions coactivated: processing efficiency improved by 25%. Overall, this project provides a new framework for understanding how a target distinctiveness is computed by the visual system, as a function of each of the target’s defining visual dimensions.

Acknowledgements: This material is based upon work supported by the National Science Foundation under Grant No BCS1921735

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1253

Investigating the activation of scene grammar for efficient search in virtual reality

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Julia Beitner[1] (beitner@psych.uni-frankfurt.de), Jason Helbing[1], Dejan Draschkow[2], Melissa L.-H. Vo[1]; [1]Department of Psychology, Scene Grammar Lab, Goethe University Frankfurt, Germany, [2]Department of Psychiatry, Brain and Cognition Laboratory, University of Oxford, United Kingdom

When searching for objects in naturalistic scenes, humans rely strongly on their previously acquired knowledge about the environment – their "scene grammar". While allowing for incredibly efficient search, the activation of scene grammar seems to require some time characterized by a substantial decrease in response times occurring between the first and second search within an environment. This Search Initiation Effect (SIE) is followed by little additional decrease in subsequent searches. Our study focused on uncovering the cognitive processes leading to this ubiquitous search efficiency profile. We used a visual search flashlight paradigm in virtual reality, in which participants could not see the full room during search but were equipped with a "flashlight" restricting the view to the illuminated parts of the room. We manipulated scene memory and the need to orient oneself, i.e., either participants entered a room and immediately started searching for objects (no preview, need to orient oneself), or they received a preview of the room in full light for 10 seconds just before search initiation (preview, no need to reorient oneself), or they received the same preview as in the preview condition but entered an empty gray room for 5 seconds before reentering the search room to start searching (preview with interruption, need to reorient oneself). Preliminary results suggest that only the preview without interruption erased the SIE implying that the availability of scene memory alone cannot circumvent the need to activate scene grammar, since the SIE was still evident when participants acquired knowledge about the room in the preview with interruption condition. Rather, our results indicate that activation of scene grammar is necessary to efficiently search even when reentering a familiar room. We will further analyze additionally collected eye tracking measures to investigate when, where, and how search initialization takes place and influences search behavior.

Acknowledgements: This work was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – project number 222641018 – SFB/TRR 135, sub-project C7 to MLV., and by the Main-Campus-doctus scholarship of the Stiftung Polytechnische Gesellschaft Frankfurt a. M. to JB.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
24 June, 5:00 am EDT America/New_York

Presenter's Message

Hi and thanks for coming to my poster! :)
I am happy to talk more about the study during one of the Zoom sessions or you can always send me an email: beitner[at]psych.uni-frankfurt.de. If you want to know more about my work, take a look at https://www.juliabeitner.com & https://www.scenegrammarlab.com.

Want to see more VR studies from our lab using the same stimuli? Then check out
Erwan David's talk "The role of central and peripheral vision for search in VR environments", ID = 1101; & Jason Helbing's poster "Semantic and syntactic anchor object information interact to make visual search in immersive scenes efficient", ID = 526.

Looking forward to talking to you!

Abstract ID: 710

Modeling visual search in naturalistic virtual reality environments

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Angela Radulescu[1,2] (angelaradulescu@fb.com), Bas van Opheusden[1,3], Fred Callaway[2], Thomas Griffiths[2,3], James Hillis[1]; [1]Facebook Reality Labs, [2]Princeton University Psychology, [3]Princeton University Computer Science

Visual search is a ubiquitous human behavior and canonical example of selectively sampling sensory information to attain a goal. Previous research has studied optimality in visual search with artificial laboratory tasks (Najemnik and Geisler, 2005; Yang et al. 2016). To understand how people search in naturalistic environments, we conducted a study of visual search in virtual reality. Participants (N=21) viewed scenes generated with the Unity game engine through a head-mounted display equipped with an eye-tracker. On each of 300 trials, participants were shown a target object and teleported into a virtual cluttered room where they searched for the item from a fixed viewpoint. They had 8 seconds to identify the target object among 60-100 distractors. Participants had a 76% success rate of finding the target with a median response time on successful trials of 2.89s (IQR: 1.99-4.44s). To understand what features drive people's search, we annotated gaze samples with semantic scene information such as the identity, shape, color, and texture of the object at the center of gaze. Concretely, we used the object asset (3D mesh and texture) to compute low-dimensional shape and color representations of each object. We found that people's gaze is primarily directed to task-relevant objects (i.e. targets or distractors), and that the distractors that people look at are close in representational space to the target. Furthermore, this distance decreased over time, suggesting that representational similarity guides eye movements. We discuss these results in the context of a meta-level Markov Decision Process model (Callaway et al. 2018), which frames visual search as optimal information sampling under computational constraints.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1401

Not too simple, not too complex: The Goldilocks principle drives discrimination and search

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Justin Halberda[1] (halberda@jhu.edu), Qian Yu[1], Zekun Sun[1], Chaz Firestone[1]; [1]Johns Hopkins University

Like Goldilocks, human babies prefer to attend to events that are neither too simple nor too complex. What is so special — or unique — about moderately complex stimuli? And might such effects generalize to visual representations in adults? If so, core visual capacities such as search and memory might operate best over such Goldilocks stimuli. To explore whether such mental processes treat different levels of complexity differently, we generated a library of visual objects across 5 complexity levels based on their cumulative skeletal surprisal (from very simple ones like various triangles to very complex polygons). When we placed these objects in a search array, we found that subjects were best able to spot the presence of moderately complex objects, compared to very simple and very complex objects. Similarly, subjects demonstrated greater memory capacity (i.e., remembered more items) for moderately complex objects, relative to very simple and very complex objects. We suggest that these effects derive from the perception of moderately complex objects as "unique". To test this hypothesis, a follow-up study asked subjects to judge whether two briefly presented objects were the same or not, and a "uniqueness score" was derived from performance accuracy. We found that both very simple and very complex objects were hard to distinguish from their counterparts of the same complexity level, and again that moderately complex objects were seen as most distinctive from one another. We propose that moderately complex objects are treated differently by the mind because they appear unique (compared to simple and complex objects). Thus, the Goldilocks principle — not too simple, not too complex — pervades the mind, spanning both infant and adult cognition and influencing core process of attention, memory, and representation more broadly.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1461

Performance on a visual search task using random dot motion stimuli

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Yelda Alkan[1] (yalkan@mednet.ucla.edu), Koorosh Mirpour[1], James Bisley[1,2,3]; [1]Department of Neurobiology, [2]Jules Stein Eye Institute, David Geffen School of Medicine, [3]Department of Psychology and the Brain Res. Inst., UCLA, Los Angeles, CA

The priority map hypothesis posits that visual attention is allocated according to the priority of objects in the visual scene. We and others have suggested that activity in priority maps during visual search might explain behavior based on the accumulation of evidence at each stimulus location (Purcell et al, 2012; Arcizet et al, 2018; Servant et al, 2019), however these studies have utilized simple stimuli that require little temporal integration of information. In this study, we use random dot stimuli in visual search to quantify how the accumulation of evidence changes under distinctive conditions within visual search. Two adult animals were trained on a visual search task in which 1, 2 or 4 random moving dot stimuli were presented. One subject indicated the presence of a target (a stimulus with rightwards motion) by making a saccade to the target. The other subject indicated the presence of a target by releasing one of two bars. The number of stimuli and the coherence of the stimuli were changed on each trial, such that all stimuli had the same coherence. Targets were present on 50% of trials for set size 1, 66% of trials for set size 2, 80% of trials for set size 4 in the saccade task and 66% of trials for set size 4 in the bar release task. In a subset of trials with a set size of 4, we also had a spatial cue condition and a feature-based cue condition. We found a decrease in performance, hit rate, and correct rejections for the greater set sizes. In the spatial cue and feature-based cue conditions, we found an increase in hit rates and decrease in reaction times. These behavioral data show that our task should allow us to measure the neural accumulation of evidence in a visual search task.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 345

Re-examining the linear separability effect in visual search for oriented targets

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Simona Buetti[1], Yujie Shao[1], Zoe Jing Xu[1], Alejandro Lleras[1]; [1]University of Illinois at Urbana-Champaign

The linear separability effect refers to a benefit in search performance observed in a feature-search task, where target and distractor features vary along a continuous feature dimension: search performance is best when there is a boundary in feature space that separates the features present in the distractor stimuli from the feature that defines the target. Search is qualitatively more difficult when there exists no such boundary separating the target from the distractor features. Here, we re-examined this effect in the context of a new procedure from Lleras et al. (2019) that quantifies the impact of distractor heterogeneity on search performance. First, one measures how well observers can find the target in homogeneous displays and then one uses the observed log-search efficiencies to predict how long it ought to take observers to find the target in heterogeneous displays in a separate experiment. Following this strategy, in Experiment 1, we evaluated how long it takes to find a tilted target oriented 20 degrees to the right of vertical, when surrounded by either distractors oriented 20 degrees to the left or 60 degrees to the right, using only distractor homogeneous displays. The log slopes of -20 and 60 degree distractors (312 and 498 ms/ln(ss)) were then used to predict performance in Experiment 2, where the target was presented in displays containing both types of distractors simultaneously. The number of distractors of each kind varied independently (2, 4, 6 or 8). Using Lleras et al.'s formula, total variance accounted for in Experiment 2 was 98.4%. Results suggest there is no "linear separability effect" in search for oriented targets. We concluded that search becomes harder due to stimulus heterogeneity, which reduces parallel processing efficiency by a factor of 1.62 (in log scale), just as is observed when intermixing images of real-life objects.

Acknowledgements: This material is based upon work supported by the National Science Foundation under Grant No BCS1921735

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Feel free to contact me by email at buetti@illinois.edu if you have additional comments or questions, or if you would like a copy of the manuscript when it is completed.

Abstract ID: 1244

Searching for the Cat: Effects of Variable Spatial Association between Objects and Scenes

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Tyler Yan[1] (17tqy@queensu.ca), Mubeena Mistry[1], Karolina Krzyś[1], Monica Castelhano[1]; [1]Queen's University

Sometimes objects are not where you expect them, but sometimes objects can be found where ever: think of a cat. In the current study, we investigated the effects of the variability of spatial associations between objects and scenes. Based on the Surface Guidance Framework, during search attention is deployed to relevant scene surfaces at a specific vertical position in the scene (i.e., upper, middle and lower surfaces; Pereira & Castelhano, 2019). However, as strength of the spatial associations between objects and scene are variable, the focus of attentional deployment may vary with it. In the current study, we examined the effect of the expected spatial variability of target objects on search performance. For each trial, participants' eye movements were tracked while they searched for one of two types of target objects: (1) Fixed Targets, which were associated with a specific surface (animal head mount, flower vase, boots); (2) Variable Targets, which were not associated with a specific region (fan, basket, cat). Results showed not only a slower reaction time for variable than fixed targets, but also an interesting pattern across eye movement measures. Attentional guidance measures showed longer times and many more fixations to get to variable than fixed targets. Interestingly, differences were not immediately apparent as the direction of the first saccade and fixations to the relevant scene region did not differ. When looking at the pattern of fixations over the course of the trial, the differences were apparent during the latter half of the search trial. This suggests that the influence of spatial expectations for variable vs. fixed targets on attentional deployment may not be immediate. We will further explore the deployment of attention over the course of the trial to address these differences in strategy implementation.

Acknowledgements: Natural Sciences and Engineering Research Council of Canada, Canadian Foundation for Innovation, Ontario Ministry of Research and Innovation

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1614

Searching high and low for the gist in 3D medical images

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Melissa Trevino[1] (melissa.trevino@nih.gov), Baris Turkbey[1], Mark Lowry[1], Bradford Wood[1], Peter Pinto[1], Marcin Czarniecki[2], Peter Choyke[1], Todd Horowitz[1]; [1]National Cancer Institute, [2]Georgetown University School of Medicine

Radiologists can identify the gist of a medical image (abnormal vs. normal) better than chance in static 2D images, after presentations of half a second or less (Evans et al., 2013; 2016). The gist of 2D real-world scenes is carried by low spatial frequency channels, which convey the structural layout of scenes (Schyns & Oliva, 1994). In contrast the gist signal in 2D mammography is carried by high spatial frequency channels (Evans et al. 2016). Standard practice in radiology is moving to 3D modalities, where each case consists of a series of images that are assembled into a virtual stack. Radiologists can extract gist from movies of these stacks (Trevino et al., 2019; Wu & Wolfe, 2019). We do not know which channels carry the gist from 3D stacks. We tested 51 radiologists with prostate mpMRI experience on 56 cases, each comprising a stack of 26 T2-weighted prostate mpMRI images. Lesions (Gleason scores 6-9) were present in 50% of cases. A trial consisted of a movie of a single case presented at 48 ms/slice. After each case, participants localized the cancerous lesion on a prostate sector map, then indicated whether a cancerous lesion was presented, and gave a confidence rating. Radiologists were divided equally into three groups who viewed either unfiltered images, low-pass (< 2 cycles/°) filtered images, or high-pass (> 6 cycles/°) filtered images. Unfiltered detection and localization performance were higher than chance (d' = 0.28; localization = 31%). Radiologists performed at chance when detecting lesions in high-pass filtered images (d' = 0.16), and were significantly lower than chance for low-pass filtered images (d' = -0.23). Our data indicate that gist perception from 3D prostate MRI relies on spatial frequency channels between 2 and 6 cycles/°. These findings emphasize that scene gist is highly dependent on task and context.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1573

Semantic and syntactic anchor object information interact to make visual search in immersive scenes efficient

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Jason Helbing[1] (jason.helbing@stud.uni-frankfurt.de), Dejan Draschkow[2], Melissa L.-H. Vo[1]; [1]Scene Grammar Lab, Department of Psychology, Goethe University Frankfurt, [2]Oxford Centre for Human Brain Activity, Wellcome Centre for Integrative Neuroimaging, University of Oxford

Visual search in naturalistic scenes is highly efficient. One crucial reason for this is attentional guidance by our knowledge of the regularities that govern those scenes—their “scene grammar”. Our study investigated the hierarchical organization of this scene grammar, focusing on “anchor objects”, which we hypothesize are essential building blocks of environmental scenes that predict the locations of other objects (e.g., the sink predicting the soap on top, the shower predicting the shampoo inside). In a virtual reality eye tracking study, we had 24 participants search for targets in navigable, immersive scene environments that were manipulated with respect to the presence of anchor objects as well as their syntactic composition. We found that concealing the semantic identity of anchors (by replacing them with grey cuboids of matching dimensions) slowed the process of locating targets in syntactically consistent scenes (i.e., objects placed in expected locations). This was apparent in the time to the first target fixation, the number of fixations, and scanpath length of search trials. Furthermore, our motion tracking data shows that subjects exhibited more extended movement in consistent scenes without intact anchors, suggesting a greater need for costly body movements in the absence of anchor context. In scenes with inconsistent syntax (i.e., objects' arrangement violates expectations), where search was overall much slower, we found the opposite effect with respect to manipulating anchors: Replacing anchors with cuboids speeded search and decreased movement, indicating that anchors lost their guiding function and became useless clutter in such inconsistent scenes. This shows how semantic and syntactic anchor object information are vital components of a scene's grammar which interact to efficiently guide both eye and body movements when we search for objects, bringing us a step closer to uncovering the hierarchical nature of scene priors and its role in efficient real-world search.

Acknowledgements: This work was supported by SFB/TRR 26 135 project C7 to Melissa L.-H. Võ.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 am EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 2:00 pm EDT America/New_York

Presenter's Message

Interested in more VR scene search + eye tracking? Check out these studies from our lab:
Julia Beitner: „Investigating the activation of scene grammar for efficient search in virtual reality“ (ID: 710)
Erwan David: „The role of central and peripheral vision for search in VR environments“ (ID: 1101)

Abstract ID: 573

Simulated tumor recognition in mammograms is biased by serial dependence

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Cristina Ghirardo[1] (cghirardo@berkeley.edu), Mauro Manassi[1,2], Teresa Canas-Bajo[1,4], William Prinzmetal[1], David Whitney[1,3,4]; [1]Department of Psychology, University of California, Berkeley, CA, USA, [2]School of Psychology, University of Aberdeen, Kings College, Aberdeen, UK, [3]Helen Wills Neuroscience Institute, University of California, Berkeley, CA, USA, [4]Vision Science Program, University of California, Berkeley, CA, USA

In radiological screening, radiologists scan myriads of radiographs with the intent of recognizing and differentiating cancerous masses. Even though they are trained experts, radiologists' human search engines are not perfect: average daily error rates are estimated around 3-5%. A main underlying assumption in radiological screening is that visual search on a current radiograph occurs independently on previously seen radiographs. However, recent studies have shown that our current perception is biased by previously seen stimuli (Fisher & Whitney, 2014; Liberman et al., 2014); the bias in our visual system to misperceive current stimuli towards previous stimuli is called serial dependence. Here, we tested whether serial dependence impacts recognition of tumor-like shapes embedded in actual radiographs. In order to simulate tumors, we created a morph stimulus set based on three canonical shapes (147 simulated tumors in total). On each trial, radiologists were presented with a mammogram containing a random simulated tumor in a random location. Observers were then asked to match the tumor shape they saw by picking the shape from a morph continuum. Twelve radiologists completed 250 trials each. We found that serial dependence affected observers' recognition of simulated tumors; simulated tumors were perceived as biased towards the simulated tumors seen in previous radiographs for 1 and 2 trials back. Hence, radiological screening was biased towards radiographs presented up to 5-10 seconds ago. Furthermore, regression analysis showed that perception on an average trial was pulled 19% and 6% toward the 1-back and 2-back trials respectively. Taken together, these results suggest that some of the diagnostic errors exhibited by radiologists may be caused by serial dependence from previously seen radiographs.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
23 June, 2:00 pm EDT America/New_York
24 June, 2:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1202

Superior colliculus activity represents future saccade goals during visual search

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Rakesh Nanjappa[1] (rnanjappa@sunyopt.edu), Robert M McPeek[1]; [1]SUNY College of Optometry

While searching for a target object in a scene, we move our eyes in a series of fixations and saccades to collect information incrementally. This requires the oculomotor system to make a series of decisions concerning where to saccade next. Previous studies suggest that this decision process can evolve dynamically, with a future saccade being planned in parallel with the current movement, rather than as a strictly serial process wherein the system chooses the goal of the next saccade only during the preceding fixation. We examined single-unit neural activity in the macaque superior colliculus (SC) related to planning sequences of saccades in a self-paced visual search task. In each trial, an array of multiple targets and distractors (distinguished by color) was presented. One of the targets was randomly selected as the stimulus which would provide a reward when fixated, and monkeys were trained to sequentially fixate different stimuli in the array until they obtained the reward. We found that monkeys more often made saccades to targets than to distractors, and that SC activity was higher for saccades made into the receptive field (RF) than elsewhere. Interestingly, SC activity was greater before and during a saccade out of the RF when a future movement would subsequently be made to the current RF stimulus. This enhanced activity suggests that SC selection of the target for a future saccade can occur during planning and execution of the current saccade. The magnitude of this enhancement depended on how soon the eye landed on the RF location after the current saccade, with a larger modulation when the RF location became the saccade goal sooner rather than later. These findings indicate that in a self-paced visual search task, the oculomotor system dynamically plans future saccades, and that SC activity represents this process.

Acknowledgements: Supported by NIH R01-EY030669

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1454

Target Discrimination vs. Detection in efficient search: What's the difference?

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Anna Madison[1], Simona Buetti[1], Alejandro Lleras[1]; [1]University of Illinois

In a fixed-target efficient search task, reaction times (RTs) have been shown to increase logarithmically with set size. The magnitude of the logarithmic slope is determined by the similarity between the target and distractors. These findings are attributed to a parallel, unlimited capacity, resolution limited architecture and have been observed in discrimination tasks where participants report a visual attribute of the target. Here we ask if the same results can be observed in a target detection task, where the target was absent 50% of the time. In a series of experiments, participants completed both a discrimination and detection efficient search task. Search task was manipulated within-subject, whereas target-distractor similarity was manipulated between experiments. The experimental set up minimized the contribution of crowding by displaying items with inter-item spacing that satisfied Bouma's law, reduced eccentricity effects by applying a cortical magnification factor that increased the size of items with eccentricity, and minimized eye-movements by briefly displaying search arrays (94 ms). In the target-present conditions of both tasks, logarithmic increases in RT performance with set size were found. These results are consistent with a parallel, unlimited capacity, resolution limited architecture. Surprisingly, RTs were overall faster in the discrimination task compared to the detection task, and search efficiency was determined by an interaction between target-distractor similarity and task. Also unexpected, the target-absent conditions did not mirror the target-present functions, showing either a decrease with set size (at low similarity) or a flat function (at high similarity). The results from the target absent condition are discussed in terms of differences in termination rule between the two tasks.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1380

The Influences of Characteristic Sounds on Visual Search Performance in Realistic Scenes

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Ghazaleh Mahzouni[1] (gmahzoun@ucsc.edu), Cary S. Feria[2]; [1]University of California, Santa Cruz, [2]San Jose State University

Research on visual search shows that presenting a characteristic sound (e.g. barking) can reduce search time for a target object (e.g. a dog) that is among other isolated objects, even when the sound provides no spatial information about the location of the search target (Iordanescu, Guzman-Martinez, Grabowecky & Suzuki, 2008). Here we investigated whether characteristic sounds can facilitate visual search in the context of realistic scenes. Across trials, we manipulated sound congruency: congruent (e.g. hearing barking while searching for a dog in a living room), incongruent (e.g. hearing meowing while searching for a dog), white noise, or no sound. We also manipulated stimulus onset asynchrony (SOA) between the sound and the scene (-1000, -500, 0, +300 ms) and target presence (present or absent). On each trial, participants (N = 55) were presented with a word cue indicating the target object, and then either (a) heard a sound followed by a scene (negative SOA), (b) heard a sound simultaneous with the onset of the scene (SOA 0 ms) or (c) viewed a scene followed by a sound (positive SOA). Results indicated that reaction times (RTs) on target-present trials depended on both sound congruency and SOA. At negative SOAs, RTs were significantly shorter in congruent trials compared to incongruent or white noise trials. At SOA of 0 ms, RTs were significantly shorter in congruent compared to incongruent trials, but not compared to white noise trials. At SOA of +300 ms, visual search performance was impaired, with RTs higher across the three sound conditions compared to all other conditions in the experiment, but there was no congruency effect. Overall, our results extend previous findings and suggest that congruent characteristic sounds can facilitate finding target objects in realistic scenes, provided that the sounds are presented before the scene.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1555

Visual Search and Size Constancy

Poster Presentation - *Topic area: Visual Search: Features, scenes*

Ronald Rensink[1] (rensink@psych.ubc.ca); [1]University of British Columbia

A commonly-used task for investigating perception is visual search. However, much of the basic nature of search remains unclear. For example, what is the nature of the items on which it operates? Are stimuli perceived in terms of visual angle, or inferred size in the world? To investigate, performance for 16 observers was assessed on displays containing 8, 16, or 24 black vertical bars against a white background; the task was to detect the presence of a longer item among shorter ones. In Condition 1, search for this display was compared against that for a version which had been compressed by a factor of 2, as well as against both of these when viewing distance was doubled. Results showed a clear effect of compression but not distance. Similar behavior was encountered for Condition 2, which was much the same except that width was held constant. Condition 3 kept all positions but used only full-sized items, so that density alone varied. Results showed no effect of density or distance. Consequently, it appears that size alone was the relevant feature in these conditions, and reflected physical rather than retinal measures. To explore the mechanisms involved, Condition 4 used a full-size display, but flickered it using various combinations of on- and off-times. Results indicated that usability of iconic memory was limited, suggesting the involvement of feedback. Condition 5 tested whether performance was affected by the wearing of an eye-patch. No reliable effect of this was found. These results provide further support for the suggestion that visual search operates over a representation that describes the physical extent of world being viewed; they also indicate that the relevant scene-based properties can be derived entirely on the basis of static global / oculomotor considerations.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

Any questions, just email me at rensink@psych.ubc.ca.

Abstract ID: 848

Visual Working Memory

Context information supports serial dependence of multiple visual objects

Talk Presentation - *Topic area: Visual Working Memory*

Cora Fischer[1] (cora.fischer@med.uni-frankfurt.de), Stefan Czoschke[1], Benjamin Peters[1,2], Benjamin Rahm[3], Jochen Kaiser[1], Christoph Bledowski[1]; [1]Institute of Medical Psychology, Goethe University Frankfurt, [2]Zuckerman Mind Brain Behavior Institute, Columbia University, [3]Medical Psychology and Medical Sociology, Faculty of Medicine, Albert-Ludwigs-University Freiburg

Visual perception operates in an object-based manner and working memory allows a flexible access to a limited number of object representations, even when they are physically no longer present. Recently, it has been shown that we compensate for small changes of an object's content features over memory episodes, which supports its perceptual stability. This phenomenon was termed 'serial dependence' and has mostly been studied in situations containing only a single relevant object. However, since we are typically

confronted with several relevant objects, the central question of how we selectively create temporal stability of several objects has remained unsolved. As different objects can be distinguished by their context features, in our case color, temporal position or spatial position, we tested whether serial dependence is supported by the congruence of context features across trials. We asked participants to remember the content features of two objects (i.e., motion directions of colored dot fields) per trial, which were presented sequentially (Experiments 1 and 2) or simultaneously (Experiments 3 and 4). At the end of a trial, one motion direction was cued for continuous report either by its color (Experiments 1 and 4), serial position (Experiment 2) or spatial position (Experiment 3). Across all experiments we consistently observed serial dependence, i.e., an attractive bias of currently toward previously memorized motion directions that was clearly enhanced when objects shared the same context feature. These findings demonstrate that the binding of an object's content (here, motion direction) and context features (e.g. color in Experiment 1 and 4) is not completely erased after a trial, but carried over to subsequent episodes. As this reflects temporal dependencies in natural settings, the present findings reveal a mechanism that supports stable representations of individualized objects over time.

Acknowledgements: German Academic Scholarship Foundation (PhD Scholarship awarded to Cora Fischer)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 5:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York

Presenter's Message

Hi, thanks for coming! If you want to read the paper presented in the talk, you can find it here: https://www.nature.com/articles/s41467-020-15874-w
If you have seen my talk at the Virtual Working Memory Symposium (VWMS), then the content in this talk won't be new for you ;) But still, I would be happy to chat if you have any questions or comments!
If you want to get in contact, write me via email (cora.fischer[at]med.uni-frankfurt.de) or find me on twitter (@c_orafischer). We can as well set up another video meeting if you would like to talk in person.

Abstract ID: 705

Neural correlates of uncertainty of visual spatial working memory in human cortex

Talk Presentation - *Topic area: Visual Working Memory*

Hsin-Hung Li[1] (hsin.hung.li@nyu.edu), Thomas Sprague[1,3], Aspen Yoo[1], Wei ji Ma[1,2], Clayton Curtis[1,2]; [1]Department of Psychology, New York University, [2]Center for Neural Science, New York University, [3]Psychological & Brain Sciences, University of California, Santa Barbara

Humans have knowledge about the quality of their visual working memory (VWM) representations (Rademaker et al., 2012; Yoo et al., 2018). This knowledge informs humans to what extent they should trust their memory when making decisions. Using a Bayesian generative model that considered both the neural and fMRI measurement noise (van Bergen et al., 2015), we previously decoded spatial VWM content from fMRI BOLD signals (Sprague et al, VSS 2017; 2019). For individual trials, this analysis extracted posterior distributions over feature values, which generated accurate estimates of remembered locations (posterior mean). Additionally, decoded neural uncertainty (standard deviation of the posterior) correlated with the VWM precision. While the previous work revealed the relation between neural uncertainty and memory precision, the neural correlates of VWM uncertainty explicitly reported by humans remain unknown. We investigated this issue in a spatial VWM task: A target dot (12° eccentricity) appeared at a randomly chosen location in each trial. After a delay, observers made a saccade to the remembered target location, and then performed a post-decision wagering task by adjusting the length of an arc presented around the reported location. Observers received points if the true target location fell within the arc, but the number of points decreased with arc length. This procedure incentivized observers to scale the arc length according to their uncertainty of VWM. We found that the posterior distribution decoded from fMRI data accurately estimated remembered locations. In the wager task, the arc length correlated with the magnitude of memory error, supporting its utility as a measure of uncertainty. Moreover, the arc length correlated with decoded neural uncertainty in V3AB and IPS, but not in early visual cortex (V1-V3). These results highlight the role of higher-level visual and parietal cortex in representing the contents of VWM in a format that reflects uncertainty.

Acknowledgements: NIH Grant R01-EY027925

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1320

Neuro-augmentation Reveals Dissociable Neural Substrates Underlying Storage and Manipulation in Visual Working Memory

Talk Presentation - *Topic area: Visual Working Memory*

Hrag Pailian[1] (hrag.pailian@gmail.com), George A. Alvarez[1]; [1]Harvard University

Visual working memory (VWM) is the ability to remember how things looked (storage), and to imagine alternative views of a scene (manipulation). Do storage and manipulation rely upon shared or separate resources? Are these abilities fundamentally limited or can they be enhanced? Here, we leverage trans-cranial direct current stimulation (tDCS) to causally modulate neural activity in regions associated with VWM, and examine effects on storage and/or manipulation. In Exp1, we applied 20-minutes of sham or anodal tDCS (counterbalanced across sessions) to the right posterior parietal cortex (r-PPC), followed by a behavioral VWM task. In this task, participants were presented with four colored circles that were subsequently occluded. For half of all trials, occluders did not move, and participants reported the color of a cued item (probing storage). For the remaining trials, two occluders swapped positions, requiring participants to manipulate the color-location bindings of the moving items. Participants were cued to report the color of either a stationary occluder (probing storage) or one that moved (probing manipulation). Neuroenhancement effects were observed for storage (by up to 23%) – but not manipulation – trials, and only for individuals with low-storage baselines. In Exp2, we determined whether this selective storage enhancement reflects a behavioral ceiling vs. a fixed storage limit, by presenting low- and high-storage performers with no-movement trials consisting of 4 or 6 colored circles. Low-storage performers demonstrated neuroenhancement effects for both set sizes, whereas high-storage individuals improved only on 6-item trials. Lastly, in Exp3, we applied anodal tDCS to the right dorsolateral prefrontal cortex (r-dlPFC) using protocol identical to that in Exp1, and observed the opposite effect: enhancement of manipulation ability (by up to 26%) – with no effect on storage. The results suggest that limits in VWM are malleable, and that storage and manipulate abilities rely upon separate resources.

Acknowledgements: Harvard Foundations of Human Behavior Initiative

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

Feel free to tweet any questions to me @hrag_p if you'd like to start a conversation thread, or leave a comment in the chat box on the VSS website.

Abstract ID: 148

Perceived and mentally rotated contents are differentially represented in cortical layers of V1

Talk Presentation - *Topic area: Visual Working Memory*

Polina Iamshchinina[1,2] (iamshchinina@gmail.com), Daniel Kaiser[3], Renat Yakupov[4], Daniel Haenelt[9], Alessandro Sciarra[5,8], Hendrik Mattern[5], Emrah Duezel[4,7], Oliver Speck[4,5,6,7], Nikolaus Weiskopf[9], Radoslaw Martin Cichy[1,2]; [1]Department of Education and Psychology, Freie Universitaet Berlin, Berlin, Germany, [2]Berlin School of Mind and Brain, Humboldt-Universitaet Berlin, Berlin, Germany, [3]Department of Psychology, University of York, Heslington, York, YO10 5DD, UK, [4]German Center for Neurodegenerative Diseases (DZNE), Magdeburg, Germany, [5]Department of Biomedical Magnetic Resonance, Institute for Physics, Otto-von-Guericke-University, Magdeburg, Germany, [6]Leibniz Institute for Neurobiology, Magdeburg, Germany, [7]Center for Behavioral Brain Sciences, Magdeburg, Germany, [8]Department of Neurology, Otto-von-Guericke University, Magdeburg, Germany, [9]Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Mental rotation typically comprises perceiving an external input and subsequently mentally transforming it in the mind's eye. These processes require feedforward and feedback information processing in visual cortex. Previous studies showed that V1 contains both the perceived and imagined representations of visual contents, posing the question how V1 can support both processes at the same time. Recent animal and human studies suggest that anatomical distinction might be key: feedforward sensory input targets the middle layer of grey matter, whereas the outer cortical layers receive feedback signals. To investigate whether perceived and mentally rotated contents are differentially represented in cortical layers of V1, we recorded 7T fMRI while participants (N=24) were briefly presented with oriented gratings and subsequently mentally rotated them. We performed depth-specific differentiation of grey matter into superficial, middle and deep layers within brain areas V1-V3 (equi-volume model). We employed pattern classification to determine shown and rotated grating orientations. Layer-specific analysis in V1 revealed differential involvement of cortical layers in perception and mental rotation, indexed by a significant interaction between cortical depth and feedforward versus feedback information flow. In detail, classification of perceived contents was higher in the middle layer than in the outer (i.e. superficial and deep) layers, whereas classification of rotated contents was higher in outer layers than in the middle layer. A similar interaction was found in V3, but not in V2. Together, this shows that perceived and mentally rotated visual contents are spatially dissociated in early visual cortex, suggesting that feedforward and feedback rely on dissociable mechanisms that manifest in distinct anatomical subregions of cortex.

This talk will be presented in Live Talk Session 2, Saturday, 20 June, 11:00 am EDT America/New_York.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 766

Prospective action imprinting into visual working memory

Talk Presentation - *Topic area: Visual Working Memory*

Daniela Gresch[1], Sage E.P. Boettcher[2], Anna C. Nobre[2], Freek van Ede[2]; [1]Ludwig-Maximilians-University, [2]University of Oxford

Visual working memory supports the retention of past visual sensations for guiding upcoming future actions. While visual working memory and action planning are often studied in relative isolation, recent evidence indicates that visual representations and their associated actions can be accessed from working memory concurrently, suggesting visual memories are held in memory together with the future actions they serve. Here, we used electroencephalography (EEG) to investigate when such prospective actions become integrated into working memory, following the selective encoding of visual shape information. Across two experiments, participants performed a visual-motor working memory task, with a pre-cue directing attention to one of two visual items that were each linked to particular manual actions at the end of the memory delay. Visual item location and the prospective response hand were independently manipulated, enabling us to independently characterise neural activity reflecting visual and motor memory attributes. In experiment 1, we further manipulated temporal expectations by probing memories after either two or four seconds. This allowed us to separate 'action encoding' from subsequent 'action preparation'. Suppression of contralateral mu-alpha and mu-beta oscillations (8-30Hz) in human motor cortex revealed encoding of the prospective action, irrespective of the time of the expected probe. This was followed by gradual action preparation which depended on the time of expected memory use, revealing a what-then-when scenario of prospective memory preparation. In experiment 2, we show that this 'action imprinting' even occurs ahead of an intervening motor task that prevented participants from preparing the action for ensuing execution. Across both experiments, action imprinting predicted visual-memory-guided actions several seconds later. Thus, our data demonstrate how future behavioural outputs are already prepared at the initial stages of visual encoding, highlighting the tight link between visual working memory and action planning, as well as the fundamentally prospective nature of this core memory function.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 8:00 am EDT America/New_York

Presenter's Message

Link to preprint: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3550240

If you have questions, feel free to contact me (gresch.daniela@gmail.com)

Abstract ID: 1017

Resilience of Working Memory Coding in the Primate Lateral Prefrontal Cortex in a Naturalistic Environment

Talk Presentation - *Topic area: Visual Working Memory*

Megan Roussy[1,2] (mroussy2@uwo.ca), Ben Corrigan[1,2], Rogelio Luna[1,2], Lena Palaniyappan[1,2], Julio Martinez-Trujillo[1,2]; [1]University of Western Ontario, [2]Robarts Research Institute

Neurons in the primate lateral prefrontal cortex (LPFC) can uniquely maintain representations of remembered stimuli in the absence of sensory stimuli and regardless of distractors. This resilience to distraction and change in environment may be key to our ability to maintain WM signals in real-world situations. Traditional spatial WM tasks in primates require sustained fixation and use simplified stimuli. It remains unclear whether under conditions with higher ecological validity-- with changing visual scenes and unconstrained eye movements-- LPFC neurons robustly maintain the contents of WM. Here we use a novel spatial WM task set in a virtual environment to demonstrate resilient encoding of WM signals in LPFC neurons. In this task, a target is presented in a virtual arena for three seconds. It then disappears, followed by a two second delay period. Movement in the environment is then enabled and animals must navigate to the target location using a joystick. Neural recordings from the LPFC (area 8A dorsal/ ventral) were performed in two male rhesus macaques using two 10x10 Utah arrays. Both animals were able to perform this task proficiently. Within a population of 2584 single neurons, we show robust spatial tuning to target location during the delay period (ventral array: 41% of neurons; dorsal array: 56% of neurons). Neural populations and neural ensembles are shown to contain large amounts of information about target location during the delay period based on high degrees of decoding accuracy on a single trial basis (~50%, 11% chance). Information content of the neural population remained stable after eye movement as well as changes in visual scene and motor activity that occurred during virtual navigation. Results demonstrate the robustness of WM encoding within the primate prefrontal cortex in the presence of eye movements and 3D navigation that reflect naturalistic conditions.

Acknowledgements: This project was funded by the Canadian Institutes of Health Research (CIHR) and The Natural Sciences and Engineering Research Council of Canada (NSERC)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
24 June, 2:00 pm EDT America/New_York

Presenter's Message

Check out the virtual WM trial example at normal speed using the following link!

https://youtu.be/GfTTHxQUN6w

Twitter:@mRoussy23
Feel free to contact me at mroussy2@uwo.ca with any questions or comments.

Abstract ID: 1390

The causal role of the medial temporal lobe in visual working memory precision

Talk Presentation - *Topic area: Visual Working Memory*

Weizhen Xie[1] (weizhen.xie@email.ucr.edu), John Wittig Jr[1], Sara Inati[2], Kareem Zaghloul[1]; [1]Surgical Neurology Branch, NINDS, National Institutes of Health, [2]Office of the Clinical Director, NINDS, National Institutes of Health

Patients with medial temporal lobe (MTL) lesions often exhibit poor retention of precise visual information in long-term memory. This deficit has been attributed to the MTL's role in pattern separation, in that MTL damage compromises the separation of similar visual information and thus reduces visual memory fidelity. However, it remains a heated debate whether the MTL is also critical for short-term retention of precise information in visual working memory (VWM). This is because the MTL is traditionally considered only relevant for long-term memory. This study aims to identify the critical role of the MTL in VWM precision. Study 1 examined how direct electrical stimulation to the MTL versus the parietal cortex affected VWM performance in 6 epilepsy patients with intracranial electrodes placed for seizure monitoring. Electrical stimulation was applied during the delay period (1 second) of a VWM color recall task. We found that hippocampal stimulation selectively reduced VWM precision, introducing more variability in recall responses (n=2). In comparison, as an active control, parietal stimulation did not significantly impact VWM precision (n=4). Study 2 further examined whether surgical removal of the MTL affected VWM performance using a within-subject design. VWM quantity and quality were measured before and after 8 patients' resection surgery for their epilepsy treatment. We found that MTL lesions (e.g., hippocampus and entorhinal cortex) markedly reduced VWM precision without affecting the quantity of remembered VWM items nor color perception (n=4). Furthermore, in 4 patients who had no MTL resection (1 insula, 1 temporal pole, and 2 no resection), we found little change in VWM measures or color perception. Together, this study provides converging evidence for the causal role of the MTL in VWM precision, which is dissociable from parietal mechanisms underlying VWM quantity. These novel findings are central to a better understanding of the nature of VWM limitations.

Acknowledgements: This study is supported by the NINDS Competitive Postdoctoral Fellowship Award

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 6:00 pm EDT America/New_York

Presenter's Message

Thank you for checking out this study. I look forward to talking with you about this line of work! Please feel free to drop me an email (weizhen.xie@nih.gov) or reach out to the chat room above.

For more updates, please follow my twitter @zanewzxie.

Abstract ID: 797

Visual search: Strategies, theory

A Computational Account of Serial and Parallel Processing in Visual Search

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Rachel Heaton[1] (rmflood2@illinois.edu), John Hummel[1], Alejandro Lleras[1], Simona Buetti[1]; [1]University of Illinois

We present a new computational model of visual search that follows on prior theoretical work by Buetti and Lleras emphasizing the contributions of parallel peripheral processing to visual search performance. The model uses concurrent parallel (distributed attention) and serial (focused attention) evaluative processes for inspecting items in a visual display. Search items are assigned random priorities for attentional selection. These priorities immediately begin to decay, and are refreshed based on feature similarity to the search template. Items are stochastically selected for focused attention based on Luce's choice axiom defined over their priorities. Selected items are matched to a search template and either accepted as the target or rejected as a distractor. During this serial process, the priorities of the remaining search items are updated in parallel, in proportion to their proximity to fixation. The resulting model successfully simulates the typical logarithmic slopes found in human data when the target-distractor similarity is medium to low (e.g., Buetti et al., 2016; Wang et al., 2017). It also produces linear search slopes when target-distractor similarity is elevated. We present simulations of these and other classic visual search phenomena, like the difference between feature and conjunction search, as well as search asymmetries.

Acknowledgements: This research was funded by NSF BCS Award #1921735.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 844

Bayesian model of human visual search in natural images

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Gaston Bujia[1,2] (gbujia@dc.uba.ar), Melanie Sclar[1], Sebastian Vita[1], Guillermo Solovey[2], Juan KamienkowskI[1,3]; [1]Laboratorio de Inteligencia Artificial Aplicada, Instituto de Ciencias de la Computación, Universidad de Buenos Aires - Consejo Nacional de Investigaciones en Ciencia y Técnica, Argentina., [2]Instituto del Cálculo, Universidad de Buenos Aires - Consejo Nacional de Investigaciones en Ciencia y Técnica, Argentina., [3]Departamento de Física, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina.

The ability to efficiently find objects in the visual field is essential for almost any everyday visual activities. In the last decades, there was a large development of models that accurately predict the most likely fixation locations (saliency maps), although it seems to have reached a plateau. Today, one of the biggest challenges in the field is to go beyond saliency maps to predict a sequence of fixations related to multiple visual tasks. Particularly, in visual search task, Bayesian observers have been proposed to model the visual search behavior as an active sampling process. In this process, during each fixation, humans incorporate new information and update the probability of finding a target at every location. Here, we combine these approaches for visual search in natural images and proposed a model to predict the whole scanpath. Our Bayesian Searcher (BS) uses a saliency map as prior and computes the most likely next location given all the previous fixations, considering visual properties of the target and the scene. We collected eye-movement visual search data (N=57) in 134 natural indoor scenes and compare different variants of the model and its parameters. First, considering only the third fixation of each scanpath, we compared different state-of-the-art saliency maps on our dataset, reaching similar AUC performances as in other datasets. But, after the third fixation, all performances diminished to almost chance level. This suggests that saliency maps alone are not enough when top-down task's information is critical. Second and more strikingly, when comparing BS models, their behavior was indistinguishable from humans for all fixations, both in the percentage of target found as a function of the fixation rank and the scanpath similarity, reproducing the entire sequence of eye movements.

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 5:00 pm EDT America/New_York
24 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1596

Does task switching ability predict the selection of attentional control strategies?

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Dana C. Shaw[1] (shaw.844@osu.edu), Heather A. Hansen[1], Molly R. McKinney[1], Jessica L. Irons[1], Andrew B. Leber[1]; [1]The Ohio State University

When performing visual search, like looking for a friend in a crowd, there are many search strategies one can employ. Recent work has shown people often use suboptimal strategies, although there are vast individual differences for such choices. Why might this be so? Here, we considered the impact of updating – i.e., task switching – on attentional strategy choice. In the real world, we rarely perform the same search multiple times in a row; we tend to move from one task to the next. Thus, optimal performance demands we update strategies frequently. Moreover, people vary considerably in task switching abilities. In this experiment we looked at the relationship between task switching performance and visual search strategy. Participants performed the Adaptive Choice Visual Search (ACVS; Irons & Leber, 2018), where they viewed a display of red, blue, and green squares for target digits. A red and a blue target were presented on each trial and participants were free to report either target. The ratio of red to blue squares changed across trials; the optimal strategy was to look through the smaller color subset. We set run lengths, or the number of trials in a row the optimal target was a particular color, to 1 and 3 for entire blocks. In a separate block of single-target visual search, we measured switch costs (RT on “switch” minus RT on “repeat” trials). We hypothesized that switch costs would relate to one’s willingness to update strategies and thus predict search optimality – especially at the 1-run blocks. Results revealed no easily discernable relationship between switch costs and optimality. These results show that metrics related to task switching ability may not underlie visual search strategy. We speculate that subjective effort of strategy updating – rather than actual costs of such updating – may determine strategy use.

Acknowledgements: NSF BCS 1632296

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 804

Effect of Global and Local Processing on Visual Search Asymmetry

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Sogol Ghattan-Kashani[1] (sogolghattan@gmail.com), Ronald Rensink[1]; [1]University of British Columbia

It is well known that Westerners show a search asymmetry for line length: search for long lines among short is faster than for short among long. In contrast, Asians given the same task show no asymmetry (Ueda et al., 2017). And asymmetry for long-term Asian immigrants in a Western country depends on the language in which task instructions are given (Cramer et al., 2016). To examine how this asymmetry depends on preceding task, 22 Westerners were given a local Navon task as a pre-task before the visual search. This task consisted of 8 blocks of 28 trials each. In the subsequent search for line length (5 blocks of 30 trials per block for each target length), average target-present slope was 35 ms/item for long targets and 52 ms/item for short (t-test: $p = 0.01$); average ratio of short- to long-target slopes was 1.46. Search was therefore asymmetric, consistent with that of Westerners tested on similar stimuli (e.g., Cramer et al., 2016). Another 23 Westerners were given a global Navon task as a pre-task. Average target-present slope was now 56 ms/item for long targets and 63 ms/item for short (t-test: $p = 0.15$); average slope ratio was 1.12. Search asymmetry was now abolished, similar to that of Asians tested on the same stimuli (Ueda et al., 2017). These results support the proposal that attention in visual search has at least two modes, with selection of mode affected by the preceding task (Rensink et al., VSS 2018) Different deployment of these modes may also explain some of the differences found in observers from different cultures, with the holistic versus analytic distinction (Nisbett et al., 2001) corresponding to the global versus local distinction in visual perception.

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Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 6:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1491

Evidence of parallel processing of Chinese characters constituting a phrase

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Jiafei Lou[1] (jiafeilou@163.com), Zhi Li[1]; [1]Zhejiang University

Whether words are processed serially or in parallel is still in debate. The serial-attention shift models, such as E-Z Reader, posit that reading proceeds in a word-by-word fashion, with lexical processing being completed with one word at a time. In contrast, the attention-gradient models, such as SWIFT, argue that readers deploy a broad gradient of attention during reading, with lexical processing distributed across several words simultaneously. In a recent study, White et al. (2019) showed that observers could not recognize two unrelated words simultaneously. In natural reading, neighboring words are often highly related. Thus, in the present study, we examined whether the collocative relation of Chinese characters may affect the processing mode (i.e., serial or parallel). Chinese character pairs (the two characters were displayed side by side) were shown in a rapid serial visual presentation (RSVP) stream. Most characters were verb. There could be at most one noun character in each side. Observers were asked to judge whether a noun was shown in a particular side, previously instructed to attend to only one side (single-task condition) or both sides (dual-task condition). The collocative relation between the Chinese characters was manipulated. The processing was closer to a parallel mode when the two characters constituted a phrase than when they were unrelated. This phrase-induced parallel processing in Chinese characters was substantially reduced when the two characters were switched in position or when there was a third unrelated character inserted in between them. These findings suggest that the collocative relation between the Chinese characters may affect the processing mode of the characters and that the processing appears in parallel when the characters constitute a meaningful phrase.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 490

Exploring the generalizability of visual search strategy

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Walden Li[1] (li.6942@osu.edu), Molly R. McKinney[1], Jessica L. Irons[1], Andrew B. Leber[1]; [1]The Ohio State University

When searching our visual environment, we often have multiple strategies available (e.g., when looking for apples on a supermarket shelf, you can look for red things, round things, or you can just serially search through all items). How do we choose a strategy? Recent research on this question has revealed substantial variation across individuals in attentional control strategies. Moreover, while attentional strategies have been found to be reliable within subjects, they have failed to generalize across different paradigms that assess various components of strategy use (Clarke et al., 2018). Thus, evidence for whether strategies generalize beyond a single paradigm remains scarce. While previous tests of generalizability used paradigms that vary in many ways, here, we focused on a single strategy component that could be preserved across tasks, while making several other changes. In two experiments, we assessed the correlation between individuals' strategies in the standard adaptive choice visual search (ACVS; Irons & Leber, 2018) and a modified novel visual search task, Spatial ACVS. In the Standard ACVS, participants seeking to perform optimally have to enumerate subsets of different colored squares and identify the smaller subset to choose a target from. Similarly, in the Spatial ACVS, participants seeking optimal performance have to enumerate spatially separate subsets of squares (one on the left and one on the right side of the display), choosing the target in the smaller subset. Participants finished both tasks in the same order in one experimental session. Results showed a positive correlation in optimal target choices between the two tasks, indicating similar strategy usage. Future studies can focus on what strategy components tend more to be generalized across tasks and whether an individual's strategy can generalize to tasks with a combination of several strategy components.

Acknowledgements: NSF BCS-1632296 (AL)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
23 June, 3:00 pm EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1471

Guided Search 6.0: An upgrade with five forms of guidance, three types of functional visual fields, and two, distinct search templates

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Jeremy Wolfe[1] (jwolfe@bwh.harvard.edu); [1]Brigham & Women's Hospital / Harvard Med

The Guided Search (GS) model of visual search was published 30 years ago. The core idea of GS is that search becomes more efficient when deployments of attention are guided by preattentive information. As new data about search accumulated, GS needed modification. Revisions have been numbered so that outdated ideas that seemed reasonable in 1989 don't need to be defended in 2020. This talk on the new GS6 will focus on three topics: 1) Five Sources of Guidance: Early versions of GS focused on top-down (user-driven) and bottom-up (salience) guidance by basic features (color, orientation, etc). Subsequent research adds guidance by history of search, "value" of the target, and, most importantly, scene structure and meaning. 2) Three "Functional Visual Fields": Visual and attentional processing are better nearer the point of fixation. This fact is captured in the idea of a Functional Visual Field (FVF) surrounding fixation. The FVF is typically treated as a single thing (notably in medical image perception). In fact, it is important to distinguish at least three, distinct co-occurring FVFs governing visual resolution, overt oculomotor exploration, and covert attentional selection. 3) In order to search, you need a representation of search target(s). This search "template" is usually discussed as though it (like the FVF) is a single mental representation. However, it is important in GS6 to distinguish between two representations: A "guiding template" that helps to direct attention to candidate targets and a "target template" that allows us to determine if a candidate is, indeed, the target. GS6 proposes that the guiding template resides in Working Memory while the target template resides in Activated Long Term Memory. I will present new data on these three topics and show how they contribute to the overall structure of Guided Search 6.0.

Acknowledgements: NEI EY017001 NCI CA207490

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
21 June, 3:00 pm EDT America/New_York
22 June, 9:00 am EDT America/New_York
23 June, 3:00 pm EDT America/New_York

Presenter's Message

Feel free to contact me at jwolfe@bwh.harvard.edu

Abstract ID: 303

Individual differences in echocardiography: Cue utilisation relates to visual object recognition ability.

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Ann Carrigan[1,2,3] (ann.carrigan@mq.edu.au), Paul Stoodley[4,5], Fernando Fernandez[6], Mackenzie Sunday[7], Mark Wiggins[1,3]; [1]Centre for Elite Performance, Expertise and Training, Macquarie University, Australia, [2]Perception in Action Research Centre, Macquarie University, Australia, [3]Department of Psychology, Macquarie University, Australia, [4]School of Medicine, Western Sydney University, Australia, [5]Westmead Private Cardiology, Westmead, Australia, [6]Blacktown Mount Druitt Hospital, Sydney, Australia, [7]Department of Psychology, Vanderbilt University, USA

Echocardiographers are highly specialised and skilled practitioners, and play a critical role in diagnostic medicine. Their responsibility is to perform dynamic ultrasounds of the heart that provide information about its structural integrity and function. Medical image perception is a visual task which is prone to error. Yet, little is known about the cognitive and perceptual attributes of experts within this domain. We examined the role of individual differences in expertise and specifically, the contribution of pattern recognition, or cue utilisation, and domain general visual expertise. Data were collected from 42 echocardiographers and 42 naïve participants. All of the participants competed the Novel Object Memory Test (NOMT; Richler et al., 2017), a measure of general object recognition ability. When compared, the echocardiographers were more accurate on the NOMT than the naïve participants. Next, the echocardiographers completed an echocardiography edition of the Expert Intensive Skills Evaluation 2.0 (EXPERTise 2.0; Wiggins, Loveday, & Auton, 2015), to establish behavioral indicators of context-related cue utilization. Behavioural indicators of higher or lower cue utilisation were established based on the participants' performance across five tasks. Echocardiographers with more experience demonstrated relatively higher cue utilization, establishing the construct validity of EXPERTise 2.0. Those with relatively higher cue utilization also performed more accurately on the NOMT. These results suggest that both a domain general perceptual ability and a sensitivity to cue based learning may contribute to expertise in echocardiography. This has important implications for the development of diagnostic skills.

Acknowledgements: Australian Research Council Discovery Scheme - DP180100425, and a Centre for Elite Performance, Expertise and Training Seeding Grant (Macquarie University).

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 139

Monetary reward motivates the adoption of optimal attentional control strategies

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Molly R. McKinney[1] (mckinney.230@buckeyemail.osu.edu), Jessica L Irons[1], Andrew B Leber[1]; [1]The Ohio State University

When given the opportunity to choose a visual search strategy (e.g. for color or shape), people often make suboptimal choices (i.e., yielding lower response time or accuracy). We have hypothesized this reflects a trade-off between minimizing effort and maximizing performance. If the most efficient strategy is cognitively demanding, some will choose a less optimal strategy, to reduce cognitive effort. It follows that increased motivation should increase one's willingness to expend effort to perform optimally. We previously reported tentative support for this (Irons & Leber, 2017, VSS); participants performed a modified version of the Adaptive Choice Visual Search (ACVS; Irons & Leber 2016), a task designed to assess attentional control strategy. Specifically, participants receiving performance-contingent monetary reward – in which faster reaction times conferred higher payoffs -- were significantly more likely to adopt an optimal strategy, compared to a random-reward control group. However, subsequent experimentation yielded smaller effect sizes and nonsignificant results. Here, to determine with confidence whether reward improves search strategy, we ran a high-powered, high-N study, via Amazon Mechanical Turk (MTurk). Interestingly, a first experiment revealed floor-level rates of optimal performance, making it impossible to assess the effect of reward and also suggesting that MTurk participants are less strategic than in-lab participants. We ran a second experiment to boost baseline rates of optimal performance, by including instructions for the optimal strategy and a "preview" of the search array (without targets) to provide more time to choose the optimal strategy (see Hansen, Irons & Leber, 2019). Results confirmed that performance contingent reward significantly increased optimal strategy usage, compared to those in the random reward group. These results support that monetary reward exerts a motivational influence to push people away from effort minimization and toward performance maximization. Additional work will futher compare strategy use in MTurk vs in-lab participants.

Acknowledgements: NSF BCS-1632296 (AL)

Presenter Conferences

The presenter has scheduled the following upcoming video conferences for this presentation.
22 June, 9:00 am EDT America/New_York

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 1671

Neural Correlates of Multidimensional Perceptual Decision Making in Macaque Frontal Eye Field

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Kaleb A. Lowe[1] (kaleb.a.lowe@vanderbilt.edu), Thomas R. Reppert[1], Jeffrey D. Schall[1]; [1]Vanderbilt University

Perceptual decision making tasks have a long history in the visual sciences to understand the organization of visual processing and to develop sophisticated models of response times in stochastic accumulator model frameworks. However, these tasks are often limited to one dimension of manipulation and the corresponding computational models are limited to one operation or stage of processing at which experimental manipulations are manifest, whereas in natural behavior decisions require the integration of information of different kinds from multiple sources. Integration of multiple sources is achieved through some processing architecture. The concept of processing architecture includes whether sources are processed in series or in parallel as well as whether or not all processes must be completed before a response is produced. Because current models do not require integration, neither the processing architecture used in a task nor the neural implementation of that processing architecture are known. To this end, we developed a multidimensional perceptual decision making task (Lowe et al., 2019). Two monkeys were trained on a GO/NO-GO visual search task, which involved explicit factorial manipulations of search difficulty and rule encoding difficulty. Performance was analyzed using systems factorial technology (Townsend & Nozawa, 1995) to assess the processing architectures used by each monkey. Here, we report the activity of frontal eye field neurons recorded during this task. We identified one sub-population of neurons modulated by search difficulty but not stimulus-response rule discrimination difficulty. We also identified a separate sub-population of neurons modulated by both factorial manipulations. These two sub-populations are key predictions of the processing architectures used by the monkeys assessed through pure behavior. The results confirm the utility of systems factorial technology in inferring the processing underlying behavior and provide first-of-its-kind insights into the neural substrates of multidimensional perceptual decision making.

Acknowledgements: Work supported by R01-EY08890, T32-EY007135, F32-EY028846, P30-EY08126, U54-HD-083211, and Robin and Richard Patton through the E. Bronson Ingram Chair in Neuroscience.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 123

Spatial cueing effect is not what we thought- An eye movement experiment

Poster Presentation - *Topic area: Visual search: Strategies, theory*

Mor Sasi[1] (mor.sasi1992@gmail.com), Daniel Toledano[1], Dominique Lamy[1]; [1]Tel-Aviv University

While there is much disagreement as to what factors determine attentional priority, most theories suggest that attention is deployed to the highest-priority object at any given time. Recently, a new model of attention, the Priority Accumulation Framework (PAF; Lamy, Darnell, Levy & Bublil, 2018), challenged this assumption. According to this model, attentional priority accumulates at each location over time, and detection of the search-relevant context (the search display) triggers the deployment of attention to the location with the highest cumulative priority. Here, we tested new predictions of this model by measuring overt shifts of attention (i.e., eye movements) in a spatial cueing paradigm, in which participants were free to move their eyes. An abrupt-onset cue was followed by a search display containing a perfect circle (the target) among three ellipses (the distractors). On any given trial the distractors could be all similar to the target (difficult-search), all dissimilar from the target (easy-search) or mixed (one similar and two dissimilar distractors). A black dot appeared inside each shape and participants had to report the location of the dot inside the target (left or right). The results revealed that early first saccades, that is, first saccades that occurred prior to processing of the search display, occurred on only one-fourth of the trials, with large individual differences, and were almost exclusively directed to the cue location. Thus, most first saccades were initiated following the search display, that is, when the cue onset had failed to capture overt attention. Crucially, however, the cue still biased the distribution of those later first saccades. Moreover, competition strength (i.e., search difficulty) strongly modulated the cue's contribution to late saccades' distribution, with a larger impact of the cue, the stronger the competition. These findings support the Priority Accumulation Framework and challenge the standard interpretations of spatial cueing effects.

Presenter Conferences

The presenter has not scheduled any video conferences for this presentation.

Presenter's Message

The presenter has not provided any messages for this presentation.

Abstract ID: 679

Speed-accuracy tradeoff of visual search: Network dynamics through spike rate correlations between supplementary eye field and visuomotor structures

Poster Presentation - *Topic area: Visual search: Strategies, theory*

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Human studies of speed-accuracy tradeoff (SAT) with non-invasive measures have offered insights but highlight uncertainty about fundamental questions regarding how the brain accomplishes SAT. Different tasks and analysis pipelines across studies identify or emphasize different cortical and subcortical regions. Several laboratories propose that medial frontal cortex sets the excursion between baseline and threshold levels of the evidence accumulation process through interactions with striatum and other regions. Using neural spiking data measured in supplementary eye field (SEF) as well as frontal eye field (FEF) and superior colliculus (SC), we investigated whether spike rate correlations across areas contribute to SAT. Two macaque monkeys performed a visual search task to locate a target (T/L) presented amongst seven distractors (L/T). Trials began when monkeys fixated a central stimulus, the color of which (green or red) cued emphasis on response speed (Fast condition) or accuracy (Accurate condition). Search contingency was fixed as either T amongst L's (less difficult) or L amongst T's (more difficult). Response time was shorter, and choice error rate, higher, in the Fast relative to the Accurate condition. We measured changes in spike count correlation (rsc) between neurons recorded in SEF and those recorded simultaneously in FEF or SC as a function of task condition, trial epoch, and trial outcome. On correct trials, we observed no effect of SAT on rsc between SEF and FEF/SC. However, on choice error trials, rsc between SEF and FEF/SC was significantly elevated in the Accurate relative to the Fast condition. In contrast, on timing error trials, rsc between SEF and FEF/SC was elevated in the Fast relative to the Accurate condition. These correlations were significantly larger after relative to before saccades. These new observations complement descriptions of medial frontal influence on SAT in humans and offer new constraints on neuro-computational mechanisms of SAT.

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