

Sticking together – hierarchical relationships between objects in scenes are reflected in neural activation patterns across time.

Aylin Kallmayer, Melissa Le-Hoa Vo

Goethe University Frankfurt, Department of Psychology, Scene Grammar Lab, Germany

The real world is rich in structure – clusters of objects frequently co-occur in scenes forming meaningful sub-units – *phrases*. Therein, larger stationary objects anchor predictions regarding smaller objects we tend to interact with. Do representations of individual objects contain such hierarchical information via shared representations between objects from the same phrase? If so, at what time and in which format during object processing do these emerge? In the present EEG study, we presented objects from four different phrases spanning two different scenes (kitchen and bathroom). We used multivariate pattern analysis (MVPA) in a cross-decoding framework to quantify shared representations between objects from the same phrase. We found phrase specific shared representations, even as the objects were presented in isolation, and more so when generalizing from anchor to local objects than reverse. Crucially, we did not find this generalization for objects from the same scene, but different phrases, providing evidence that the phrase sub-unit gives structure to representational spaces underlying fast and automatic object processing. To conclude, we provide evidence that the visual system represents a more fine-tuned hierarchical structure of object relationships which reflects object co-occurrence statistics in the real world during fast and automatic object processing than previously assumed. This has important implications not only regarding our understanding of core object representations but importantly it also furthers our understanding of the mechanisms behind hierarchical predictions as observed in efficient guidance of attention and (inter)actions across a range of real-world visual search tasks.