

# Out of sight: The Impact of Hidden Objects on Visual Search in 3D Scenes.

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Virtual reality (VR) has opened up a vast array of possibilities for studying visual search. Despite the new opportunities it offers, past research has largely overlooked the potential of interaction with the virtual environment during search. Target objects were always positioned in visible locations and very rarely hidden. In reality, however, objects frequently appear inside others, such as yogurt in a fridge. We created interactive virtual environments to mimic a quasi-natural visual search situation. Fifty-six unique target objects were placed in 28 3D-modelled indoor rooms. Target objects were placed either at visible or hidden locations. Object placement was further conditioned on the objects' "degree of constraint" (i.e., likelihood to appear in multiple locations in scenes or being anchored to a specific object), such as a monitor to a desk. The experiment consisted of two blocks: a search phase, and a repeated search phase (as a memory probe). Our findings revealed longer search durations, and interaction counts when targets were hidden. Moreover, constrained placements resulted in shorter search durations even for hidden objects highlighting the importance of scene grammar in guiding visual search. Looking for hidden objects, participants prioritized scanning visible areas of a room before considering the likelihood of an object being hidden to avoid missing potentially "low hanging fruit". During the repeated search phase, scanning times were reduced for hidden objects, and verification times were reduced for visible objects. This suggests that participants relied more on scene memory rather than object memory. Overall, finding a hidden object was more demanding and required an interactive exploration of the environment. Therefore, we argue that future studies on visual search need to include hidden objects to become more ecologically valid. With this experiment, we contribute to a broader understanding of how VR can move visual search experiments closer to the real world.