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Saccades to Partially Occluded Objects: Perceptual Completion Mediates Oculomotor Control

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Abstract

Oculomotor behavior is ultimately controlled by patterns of activity in retinotopically organized populations of neurons in areas, such as the superior colliculus and frontal eye fields, that have visuomotor receptive fields. In contrast, gaze is guided by non-retinotopic variables including task goals, attentional state, and the perceived 3 dimensional structure of the environment. We investigated how the implied extent of perceptually completed surfaces behind occluding surfaces impacts saccade landing position while searching for small targets. Each trial included four disks and four truncated disks. On half of the trials, rectangles abutted the truncated disks supporting the perception of completed disks behind occluding surfaces. Observers searched among the disks for small red or green dots, which appeared only when a saccade landed within a disk region. This design leveraged the tendency for saccades to land near the center of objects (e.g., Melcher & Kowler, 1999) to ask what constitutes an “object” to the eye-movement control system, the perceptually extended whole disk or the optically explicit truncated disk? Experiment 1 showed that distributions of landing position were biased toward the center of the implied whole disks and away from the optically explicit portion of the disk when occluders were present. Experiment 2 showed the same bias toward the center of the whole disk despite the location of the colored dot being presented at the center of the image region, which would have given a strategic advantage to use the image level representation. Experiment 3 used complementary contrast regions to demonstrate that the landing position bias shown in Experiments 1 and 2 were not due to low-level stimulus interactions caused by

the presence of occluders. Taken together, these results indicate that oculomotor control mechanisms operate over object-level representations during the planning and execution of eye movements.