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Size constancy is not accomplished in the early stage of visual processing

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Abstract

Within a certain range, people's perception of the size of an object will not change with viewing distance, even though the size of the image projected on the retina changes. This is called size constancy. To achieve size constancy, it is necessary to compensate for changes in retinal image size with distance by using a range of depth cues. When and where depth cues act on the representation of size is still unclear. Here we used ERPs to address this question. A black disk, which could be small or big, was presented on a white background at a near or far viewing distance. The near-small and far-big conditions had the same retinal size. The near-small and far-small conditions had the same perceived size, as did the near-big and far-big conditions. Participants were tested in a dimly-lit room with all depth cues available. They were asked to indicate whether the disk was small or big regardless of distance (Experiment 1) or to detect the onset of the disk (Experiment 2). In both experiments, we found that within the first 150 ms after stimulus onset, the ERP waves of the two conditions that had the same retinal size overlapped. After 150 ms, the ERP waves grouped and synchronized according to their physical size (i.e., perceived size) regardless of distance. Because both C1 (which is thought to reflect the response of V1) and P1 (which is thought to reflect the response of extrastriate visual cortex) emerge within the first 150 ms, our results suggest that size constancy is computed after 150 ms in higher-order visual areas beyond V1 and extrastriate cortex. Thus, the size-constancy related fMRI activation that has been observed in V1 may depend on back-projections from these higher-order areas.

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