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Presentation Abstract

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Title:	Does Emmert's Law operate in primary visual cortex?
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Authors:	***I. SPERANDIO**, P. A. CHOUINARD, L. STROTHER, M. A. GOODALE; Psychology, Univ. of Western Ontario, London, ON, Canada

Abstract:

Background: An afterimage is an unchanging image on the retina that continues to be perceived after the exposure to the original image has ceased. Like a shadow, an afterimage can be "projected" upon a surface at different distances. Emmert's Law (1881), which specifies a direct relation between perceived size and perceived distance, was originally formulated in terms of after-images: the perceived size of an after-image is proportional to its apparent distance (i.e., an after-image looks bigger when fixating on a distant as opposed to a near surface). As such, after-images represent a potentially illuminating case to demonstrate how the brain scales size as the distance changes. But at what levels in the visual system does this size-distance invariance mechanism operate?

Methods: To answer this question, we carried out a functional magnetic resonance imaging (fMRI) study. The experiment was conducted in a dimly lit room where a variety of distance cues were available. Participants were instructed to direct their gaze at a circular spot of light projected on a screen for 4 s to generate a robust after-image. Following this, participants judged the size of the after-image projected onto a second screen placed at different distances from the eyes. In addition, participants were asked to respond at the start of the after-image by pressing a key that was released once the image had faded from perception.

Results: We found that the area of activation in the primary visual cortex (V1) corresponding to the after-image increased in size as a function of the distance of the screen on which the afterimage was observed: i.e., the greater the distance, the bigger the perceived size, and the bigger the area of activation in V1 - even though the retinal image remained constant in size.

Conclusion: These results provide further support for the idea that retinal image size and depth/distance information are combined early in the human visual system, probably at level of V1. Interestingly, this finding is in broad agreement with a recent fMRI study by Murray et al. (2006), who used the Ponzo illusion to demonstrate that

the area of activation in V1 associated with a visual stimulus of fixed size changed as a function of its apparent distance. The novelty here is that an after-image, in contrast to external visual stimuli, has an absolutely fixed angular size on the retina no matter what the distance it is observed. Moreover, in contrast to Murray et al.'s study, distance was manipulated directly and not by means of perspective optical illusions.

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