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Catching and matching bars with different orientations

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Abstract

The hypothesis that perception enslaves action is examined by assessing whether systematic distortions in perceptual judgments are reflected by inaccuracies in catching. In the first experiment, participants had to align manually the orientation of a reference bar placed at different distances in the frontoparallel plane. In the second experiment participants had to catch differently orientated moving bars, which became invisible at different distances from the interception point. In the matching experiment, systematic errors in the alignment of orientation were found in particular for oblique orientations, the magnitude of which increased with increasing distance of the reference bar. The inaccuracies in the final hand orientation during the catching task, however, did not mirror this pattern of deviations. The findings are interpreted to be more consistent with recent views that vision for perception (i.e., matching) and vision for action (i.e., catching) are dissociated than with the view that perception enslaves action.

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1. Introduction

To date, there has been much work on how we perceive the spatial layout of the world around us. A common observation has been that the Euclidean geometric relations are distorted with respect to distance, location, size, shape, and orientation in the perceived world (Blumenfeld, 1913; Foley, 1980, 1991; Helmholtz, 1962; Hillebrand, 1902; Indow, 1991; Koenderink & van Doorn, 2000; Tittle, Todd, Perotti, & Norman, 1995). It has been observed, for example, that participants show systematic deviations in their perceptual judgements when asked to indicate the halfway point between themselves and a point straight in front of them (Foley, 1967, 1972; Gilinsky, 1951). Concerning orientation, the topic under study here, it has been found that systematic deviations occur when participants are asked to match the orientation of lines or bars in the frontoparallel plane. These deviations appeared larger for oblique orientations than for cardinal orientations, and increased with larger lateral distances of the reference lines or bars (Cuijpers, Kappers, & Koenderink, 2000, 2001; Hermens & Gielen, 2003b; Soechting & Flanders, 1993).

The accurate perception of orientation, distance, and size is often considered indispensable for adaptive actions like grasping and catching objects. This has prompted the issue as to how humans can act accurately (in grasping, catching, and walking) in the face of the observed perceptual distortions. According to one hypothesis, which can be traced back to Descartes (Rossetti, 1998), humans construct from perceptual and cognitive processing one internal representation of the physical environment. This internal representation is thought to form the basis of both conscious experience of the world, and the control of actions (such as grasping, catching, and walking). If this hypothesis is correct, then traces of the perceptual distortion should become apparent in the control of actions. Indeed, there are reports that may be interpreted to support the enslaving hypothesis. Philbeck and Loomis (1997), for instance, found that the distance errors made when walking blindfolded to a remembered target location are related to the errors in perceived distance (cf. Pagano, Grutzmacher, & Jenkins, 2001). Recently, Hermens and Gielen (2003a) have reported similar findings relating to orientation. Participants were presented with a line in various orientations that moved on a vertical screen in the frontoparallel plane towards the participant. The participants were required to align the orientation of a bar with the orientation of the moving reference line at the precise location and time when the line passed in front of the participant. According to Hermens and Gielen (2003a) participants thus intercepted the reference line, and interpreted the task as a catching action. During one condition the line became invisible during its movement. Again, the participants were required to align the orientation of the bar with that of the line at the predefined location at the moment the line would have passed the participant. Participants made significant orientation errors for oblique orientations, but not for cardinal