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Dissociating size representation for action and for conscious judgment: Grasping visual illusions without apparent obstacles

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Abstract

Visual illusions provide important evidence for the co-existence of unconscious and conscious representations. Objects surrounded by other figures (e.g., a disc surrounded by smaller or larger rings, Ebbinghaus/Titchener illusion) are consciously perceived as different in size, while the visuo-motor system supposedly uses an unconscious representation of the discs' true size for grip size scaling. Recent evidence suggests other factors than represented size, e.g., surrounding rings conceived as obstacles, affect grip size. Use of the diagonal illusion avoids visual obstacles in the path of the reaching hand. Results support the dual representation theory. Grip size scaling follows actual size independent of illusory effects, which clearly bias conscious perception in direct comparisons of lengths (Experiment 1) and in finger-thumb span indications of perceived length (Experiment 2).

Keywords: Visual illusions; Perceptual judgement; Knowledge for action; Implicit knowledge; Conscious perception; Obstacles avoidance

1. Introduction

The theory that it is possible to have visually gained knowledge without conscious awareness has been greatly helped by the finding from blindsight patients (e.g., Perenin & Rossetti, 1996;

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Pöppel, Held, & Frost, 1973; Weiskrantz, Sanders, & Marshall, 1974; Weiskrantz, 1998). Despite complete lack of conscious perception of stimuli in the 'blind' part of their visual field they can, nevertheless, fairly accurately point to the stimulus or accurately act in other ways in relation to it. Support for the existence of similar dissociations in neurologically healthy people comes from experiments with illusory stimuli. Early demonstrations relied on motion illusions using the induced Roelofs Effect investigating eye gaze (Wong & Mack, 1981) and manual action (Bridgeman, Gemmer, Forsman, & Huemer, 2000; Bridgeman, Kirch, & Sperling, 1981). More recently, Aglioti, DeSouza, and Goodale (1995) used the Ebbinghaus/Titchener circles illusion to show a corresponding dissociation. When asked to indicate which of two discs of the same size was larger, the one surrounded by smaller rings was judged larger than the one surrounded by larger rings—in keeping with the known effect of this illusion. However, the grip size scaling (thumb finger opening on the way to grasping a disc) was about the same, indicating that the sensory-motor system allegedly uses a different—more accurate—representation (knowledge) of the discs' true sizes than conscious perception. This interpretation of the original finding by Aglioti et al. (1995) has, however, come in for much criticism.

We concentrate here on the question whether the results of this experiment or any of its later variations requires for their explanation the existence of two contradictory representations of reality (dual representations model)—one of which is available to conscious awareness and the other one is not—or whether they can be explained on the basis of a single, conscious representation (single representation model). For answering this question the following aspects of the experimental setup and model of relevant mental processes are critical. In the basic setup a particular stimulus object is presented and one of its properties (e.g., its size) is assessed by two different response modes (e.g., a verbal judgment and a grasping action) which yield contradictory response mode information about the stimulus property. The dual representations model assumes that the contradictory information in the different response modes comes from different representations. However, the single representation model can also explain this contradictory response mode information if one of the following two possibilities arises:

1. The mapping from stimulus to internal representation is not constant over the two tasks in which each response mode is used. Pavani, Boscagli, Benvenuti, Rabuffetti, and Farnè (1999) and, in particular, Franz, Gegenfurtner, Bülthoff, and Fahle (2000) have capitalized on this possibility by observing that the size of the illusory effect is much stronger when the two discs in each display, one disc surrounded by smaller the other disc by larger rings, are directly compared than when a disc in one of these displays is compared to a plain disc (without any surrounding rings). Participants in Agliotti's experiment had to judge size by comparing both displays, resulting in relatively large differences between represented and actual size. In contrast, participants had to grasp only one of the two discs, which might have restricted their attention to only that particular disc, attenuating the illusory effect and, consequently, resulting in seemingly more accurate grip size differences. Hence, on each occasion only a single representation of each disc's size might be formed, but due to the attentional differences (attend to both displays for judgment but only to one when grasping) that representation is more accurate in the grasping than in the judgment task. Consequently, the single representation theory can adequately explain the difference in manually and verbally expressed size.
2. Extraneous reasons for acting may bias the action response. When asked to give a conscious judgment of the size of a disc then the best estimate available is the size as internally represented.