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Crossmodal change blindness between vision and touch

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Abstract

Change blindness is the name given to people's inability to detect changes introduced between two consecutively-presented scenes when they are separated by a distractor that masks the transients that are typically associated with change. Change blindness has been reported within vision, audition, and touch, but has never before been investigated when successive patterns are presented to different sensory modalities. In the study reported here, we investigated change detection performance when the two to-be-compared stimulus patterns were presented in the same sensory modality (i.e., both visual or both tactile) and when one stimulus pattern was tactile while the other was presented visually or vice versa. The two to-be-compared patterns were presented consecutively, separated by an empty interval, or else separated by a masked interval. In the latter case, the masked interval could either be tactile or visual. The first experiment investigated visual–tactile and tactile–visual change detection performance. The results showed that in the absence of masking, participants detected changes in position accurately, despite the fact that the two to-be-compared displays were presented in different sensory modalities. Furthermore, when a mask was presented between the two to-be-compared displays, crossmodal change blindness was elicited no matter whether the mask was visual or tactile. The results of two further experiments showed that performance was better overall in the unimodal (visual or tactile) conditions than in the crossmodal conditions. These results suggest that certain of the processes underlying change blindness are

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multisensory in nature. We discuss these findings in relation to recent claims regarding the crossmodal nature of spatial attention.

Keywords: Spatial perception; Change blindness; Attention; Multisensory perception; Sensory modality

1. Introduction

The large body of empirical research on the phenomenon of change blindness in vision demonstrates that observers often experience difficulties in detecting changes taking place between successive views of a visual scene when some form of disruption (or transient) occurs between the two presentations of the scene. Change blindness has been observed when changes occur during saccades (Henderson, 1997; Irwin, 1991), eye blinks (O'Regan, Deubel, Clark, & Rensink, 2000), when a blank screen, or "flicker", is inserted between the original and modified images (Pashler, 1988; Rensink, O'Regan, & Clark, 1997; Simons, 1996), and when small black-and-white "mudsplashes" are superimposed over parts of the image during the change (even though the mudsplashes themselves do not cover the change; O'Regan, Rensink, & Clark, 1999). Change blindness can also be elicited when changes occur very slowly (Auvray & O'Regan, 2003; Simons, Franconeri, & Reimer, 2000), when scene cuts occur in film sequences (Hochberg, 1986; Levin & Simons, 1997), during real-life change (Simons & Levin, 1998), and by constant and smooth oscillatory motion of the whole image (even in the absence of any other form of masking during the change; Schofield, Bishop, & Allan, 2006).

Explanations of the phenomenon of change blindness in vision are usually based on the notion that the visual system is particularly sensitive to changes in colour or luminance in the visual field (see Simons & Rensink, 2005). Under normal viewing conditions, these changes create a transient signal in the visual field that is detected by low-level perceptual mechanisms, and hence attention is thought to be exogenously attracted to the location of the change. Change blindness paradigms are therefore considered to work because they utilize experimental protocols that successfully mask the local transients that would normally be associated with change. Given that attention is no longer attracted to the location of any change, observers have to rely on their memory of the scene in order to infer what may have changed. In this case, changes will tend to be noticed more rapidly if they occur at locations which are likely to attract attention because they are somehow "interesting" to the observer (Rensink et al., 1997). The particular elements in a given scene on which we happen to focus our attention reflect both physical factors, such as the salience (size, intensity, etc.) of the stimuli, as well as semantic factors, such as their interest (central vs. marginal) or scene consistency (e.g., Auvray & O'Regan, 2003; Gibson & Crooks, 1938; Rensink et al., 1997).

Change blindness is not, however, restricted to the visual modality. The inability of people to detect a change occurring at the same time as some form of disruption has also been reported within the auditory modality, where the phenomenon has been labelled 'change deafness'. For example, when participants in a study by Vitevitch (2003) had to repeat a stream of words in a shadowing task, they failed to detect the change in the identity of the talker. Change deafness can also be elicited when a white noise auditory mask is presented at