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Infants detect changes in everyday scenes: The role of scene gist

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ABSTRACT

When watching physical events, infants bring to bear prior knowledge about objects and readily detect changes that contradict physical rules. Here we investigate the possibility that scene gist may affect infants, as it affects adults, when detecting changes in everyday scenes. In Experiment 1, 15-month-old infants missed a perceptually salient change that preserved the gist of a generic outdoor scene; the same change was readily detected if infants had insufficient time to process the display and had to rely on perceptual information for change detection. In Experiment 2, 15-month-olds detected a perceptually subtle change that preserved the scene gist but violated the rule of object continuity, suggesting that physical rules may overpower scene gist in infants' change detection. Finally, Experiments 3 and 4 provided converging evidence for the effects of scene gist, showing that 15-month-olds missed a perceptually salient change that preserved the gist and detected a perceptually subtle change that disrupted the gist. Together, these results suggest that prior knowledge, including scene knowledge and physical knowledge, affects the process by which infants maintain their representations of everyday scenes.

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1. Introduction

Visual experience is complex and ever changing as eyes switch focus from one point to another in the environment. Attending to all changes would be daunting and inefficient for the viewer; selective attention is necessary to process visual information rapidly in everyday life. Consequently, certain changes to a scene become prioritized over others in the visual representational system, and the viewer detects some changes while overlooking others (e.g., Hollingworth, 2003, 2006; Hollingworth & Henderson, 2000; Rensink, 2002; Simons & Ambinder, 2005; Wang & Mitroff, 2009). The present research investigates the developmental continuity in this prioritizing process and examines whether *scene gist* affects infants, as it affects adults, when they attend to everyday scenes.

In order to detect a change, the viewer needs to encode the pre-change information, maintain this information over time, and compare it to the post-change information (e.g., Simons & Ambinder, 2005). By manipulating contextual congruity and perceptual salience, prior research has gathered converging evidence showing that both knowledge- and perception-based processes can interfere with scene representation and affect change detection (Beck & Levin, 2003; Davenport & Potter, 2004; Hollingworth, 2003, 2006; Hollingworth & Henderson, 2000; Joubert, Rousselet, Fize, & Fabre-Thorpe, 2007; Mitroff, Simons, & Levin, 2004; Rensink, 2000, 2002; Simons & Ambinder, 2005). For example, identifying an object in a glimpse (80 ms) is less accurate when the object appears in an improbable than a probable scene (e.g., football player in the church versus in the football field), suggesting that scene congruity facilitates visual perception, whereas scene incongruity hinders the process and thereby calls for additional viewing time for scene representation (Davenport & Potter, 2004). Although perceptual features of a scene, such as color contrast, affect the viewer's ability to represent the details of the scene, knowledge plays a pivotal role in change detection (e.g., Nijboer, Kanai, de Haan, & van der Smagt, 2008; O'Regan, Rensink, & Clark, 1999).

It has been proposed that the initial representation of a scene includes the overall meaning of the scene—termed *scene gist*—in addition to its general perceptual characteristics (e.g., Hollingworth, 2006; Oliva, 2005; Rensink, 2000, 2002). For example, when the viewer recognizes a scene as related to *parks*, the gist of *a park scene* is extracted and serves as an overarching structure that guides scene representation. Consequently, changes that preserve the gist (e.g., trees replaced by water fountains) can be easily overlooked, whereas changes that disrupt the gist (e.g., trees replaced by bathroom sinks) may capture attention and be easily detected (Rensink, 2000; Simons, 2000). According to this view, perceptually salient changes may go undetected as long as the scene gist is preserved; supporting results have been widely obtained with adults, demonstrating a phenomenon termed *change blindness* (e.g., Levin & Simons, 1997; Sampanes, Tseng, & Bridgeman, 2008). For example, Levin and Simons (1997) showed that participants failed to notice a salient change when the sole actor in a video clip was changed between the scenes (e.g., in the first scene actor A leaves the office to answer a phone, and in the next scene actor B enters the hallway to pick up the phone). Even though the actor was the main feature of the event, the participants missed the change because the meaning of the event remained unchanged when the new actor carried out the unfinished action of the previous actor. Another implication of gist-guided representation is that change detection may vary across individuals as a function of scene knowledge. For example, viewers with expert knowledge (e.g., knowledge about football players' strategic positions) were quicker than novices at detecting changes that altered the overall scene meaning (Werner & Thies, 2000; see also Hollingworth & Henderson, 2000; Nijboer et al., 2008).

With limited knowledge, infants can be considered novices in many respects and assumed to rely primarily on perception-based processes for scene representation; however, it can be argued that infants also actively apply relevant knowledge in this process. On the one hand, the visual memory system undergoes rapid development during the first year, allowing infants to notice perceptually salient changes. By 3 months of age, infants perceive the visual world in rich color details as adults do (see Atkinson, 1998), with some acuity to identify and distinguish elements of a scene. Before the first birthday, their visual short-term memory reaches adult capacity, allowing them to track simultaneous changes to multiple visual stimuli (e.g., Cheries, Wynn, & Scholl, 2006; Ross-Sheehy, Oakes, & Luck, 2003). On the other hand, research has shown that infants' knowledge about the world mediates their