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Eye Tracking as a Tool for the Detection of Simulated Memory Impairment

Elaine J. Mahoney
University of Wisconsin – Milwaukee, USA

Narinder Kapur
University College London, UK

David C. Osmon, Deborah E. Hannula*
University of Wisconsin – Milwaukee, USA

Effects of feigned memory impairment on eye-movement behavior were investigated. Participants encoded scene–face pairs and were tested with displays containing three studied faces preceded by a studied scene. Half of these displays contained the face that had previously been associated with the scene cue, while the remainders did not. Participants made presence/absence judgments while eye movements were recorded and either attempted to perform optimally (controls) or feign impairment (simulators). While explicit recognition was at chance among simulators, both groups looked disproportionately at associates early in the trial. The magnitude of this effect was matched across groups and significant even when simulators made incorrect recognition responses. Eye tracking may have potential as a tool for the detection of concealed recognition and warrants further research into its efficacy and underlying mechanisms.

Author Note

Elaine J. Mahoney, David C. Osmon, and Deborah E. Hannula, Department of Psychology, University of Wisconsin – Milwaukee, Milwaukee, WI, USA; Narinder Kapur, Research Department of Clinical, Health, and Educational Psychology, University College London, London, UK.

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* Correspondence concerning this article should be addressed to Deborah E. Hannula, Department of Psychology, University of Wisconsin – Milwaukee, 2441 E. Hartford Avenue, Milwaukee, WI 53211, USA. Contact: hannula@uwm.edu

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General Audience Summary

When cognitive deficits occur as a consequence of injury, support may be available to compensate for resulting disability, including financial settlements, payments to account for lost wages, and access to healthcare resources. However, there are individuals who attempt to take advantage of this system by faking or exaggerating symptoms, a problem that is incredibly costly to society. Therefore, it is critical to identify tools that can be used to detect deliberate suboptimal performance on cognitive tests. The objective of the current study was to investigate the potential utility of eye tracking as a tool for this purpose. Participants completed a memory task that required them to learn scene–face pairs. Subsequent to learning, a memory test was administered. At this point, participants were shown a studied scene and then a display with three studied faces was superimposed on top of the scene—sometimes the face that had been paired with the scene was present in this 3-face display. When the test display was presented, participants pressed a button to indicate whether the matching face was present or not. One group was instructed to do their best (controls) and a second group was instructed to fake memory impairment (simulators). Results indicated that while simulators could successfully conceal memories in button press responses, both groups looked at the face that had been paired with the scene shortly after the 3-face display was presented, thus revealing their memory for the pair. This effect was seen even when simulators indicated, via button press, that the matching face was not present. As such, we believe that eye tracking may have some utility in attempted detection of concealed recognition, though additional work is required to identify and examine strategies that might affect eye-movement behavior when individuals are motivated to appear impaired.

Keywords: Eye tracking, Malingering, Concealed memory, Relational memory, Associative memory

Most of us have experience with the act of concealing knowledge. Much of the time, this kind of behavior is innocuous. For example, we might pretend not to have met someone in the past when it becomes clear they do not remember that experience. However, this behavior can also have important consequences when individuals attempt to hide memories in service of financial gain or other incentives (Chafetz & Underhill, 2013; Denning & Shura, 2017). The current investigation combines explicit recognition responses with indirect measures of eye-movement behavior to examine whether and how patterns of viewing elicited by learned materials are affected by instructions to simulate memory impairment.

Past work indicates that eye movements are a sensitive index of memory (Hannula et al., 2010). For example, studies show that memory has a rapid influence on allocation of eye movements to materials learned in the context of a long-term memory task when the instructed objective is to identify encoded materials (e.g., Hannula, Ryan, Tranel, & Cohen, 2007; Ryan, Hannula, & Cohen, 2007). In one such study, participants learned scene–face pairs and were tested with three studied faces preceded by a studied scene cue. Following cues, neurologically healthy participants looked disproportionately at associates within 500–750 ms of display onset (Hannula et al., 2007; see also Baym et al., 2014; Chua, Hannula, & Ranganath, 2012; Williams et al., 2010). This memory-based viewing effect occurred in advance of explicit recognition responses, has been reported when scene cues were masked from view (Nickel, Henke, & Hannula, 2015), and is evident even when it is counterproductive to prioritize the associate because participants were instructed to learn the new associations rather than identify old ones (Hannula et al., 2007). Based on outcomes like these, we have proposed that early viewing effects may be an automatic or obligatory consequence of retrieval processes that are mediated by structures such as the hippocampus, initiated when memory cues are presented (Hannula & Ranganath, 2009).

Together, the rapid onset of memory-based viewing effects and their resistance to disruption across a range of manipulations (see also Ryan et al., 2007) suggests that they may afford insight into past experience even when participants attempt to behave in a deceptive manner. Consistent with this possibility, results from recent studies (Millen, Hope, Hillstrom, & Vrij, 2017; Peth, Kim, & Gamer, 2013; Schwedes & Wentura, 2012, 2016) indicate that eye movements distinguish encoded from novel materials when simple tests of item memory are administered in combination with instructions to conceal remembered content. For example, Schwedes and Wentura (2012) reported that the duration of second fixations to encoded faces was longer than the duration of second fixations to novel faces despite instructions to conceal memory by selecting an unknown face from multiple-face displays. Furthermore, standard effects of familiarity on eye-movement behavior (Althoff & Cohen, 1999) have been reported when participants lie about known faces (Millen et al., 2017)—participants made fewer fixations to personally familiar and famous faces than to novel faces despite reporting that known faces were unfamiliar. These observations provide initial support for the view that eye movements may reveal memory despite attempted deception.

In the study reported here, participants completed the relational (scene–face) memory task described above (cf. Hannula et al., 2007; see the supplement and Hannula et al., 2010, for additional information), but now, one group was instructed to simulate memory impairment. A notable difference between this work and previous eye tracking investigations of concealed memory is that the same basic task, absent instructions to

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