Consciousness and Cognition 65 (2018) 152–168

Contents lists available at ScienceDirect

Consciousness and Cognition

journal homepage: www.elsevier.com/locate/concog

Full Length Article

Exploiting failures in metacognition through magic: Visual awareness as a source of visual metacognition bias

Jeniffer Ortega[a,*], Patricia Montañes[a], Anthony Barnhart[b], Gustav Kuhn[c]

[a] Department of Psychology, National University of Colombia, Bogotá D.C., Colombia
[b] Department of Psychological Science, Carthage College, Kenosha, WI 53140, USA
[c] Department of Psychology, Goldsmiths University of London, London SE14 6NW, UK

ARTICLE INFO

Keywords:
Visual metacognition
Metacognitive biases
Visual awareness
Cognitive illusions
Eye movements

ABSTRACT

We used cognitive illusions/magic tricks to study the role of visual awareness as a source of biases in visual metacognitive judgments. We conducted a questionnaire-based study (n = 144) and an eye tracking study (n = 69) in which participants watched videos of four different magic tricks that capitalize on failures of visual awareness (inattentional blindness and change blindness). We measured participants' susceptibility to these illusions, their beliefs about other people's susceptibility, as well as the role that fixating (i.e. eye position) the critical event has on detecting the secret. Participants who detected the method of the tricks believed it was more likely that other people would detect it compared to those participants who failed to notice the method. Moreover, they believed that they moved their eyes to look at it. Eye tracking data show that, contrary to participants' beliefs, peripheral vision played a significant role in detecting the method. Overall, the findings from these studies suggest that visual awareness may bias visual metacognitive judgments.

1. Introduction

Our visual experience supports the belief that we have a rich, uninterrupted visual mental representation of the world (Blackmore, 2002; Cohen, Dennett, & Kanwisher, 2016; Dennett, 2002). Current psychological and neurophysiological data demonstrate that this belief is a compelling illusion; one we rarely challenge. An indication of this erroneous belief can be seen in people's surprise when they discover failures in visual awareness, such as inattentional blindness (Mack & Rock, 1999) and change blindness (Rensink, O'Regan, & Clark, 1997). For example, people are often astonished to discover they failed to notice the gorilla (Simons & Chabris, 1999), and the fact that this illusion has been viewed more than 50 million times online is a true testimony to how surprising it is. This surprise may be interpreted as resulting from overestimation of perceptual skills combined with erroneous beliefs about mental representations (Cohen, 2002; Dennett, 2002).

We have some insights into our cognitive processes (Nelson & Narens, 1994; Van Overschelde, 2008). For instance, we intuitively know that dividing attention reduces the ability to notice visual stimuli (Finley, Benjamin, & McCarley, 2014). However, we can be oblivious to some of our cognitive limitations (Kahneman, 2011), such as the failure to notice unexpected salient changes in our environment (Beck, Levin, & Angelone, 2007a; Levin, Momen, & Drivdahl, 2000), the inability to faithfully record events that we see and hear (Simons & Chabris, 2011), or the lack of color vision in the periphery of our visual fields (Dennett, 2005). This blindness to our blindness is one of the most striking features of metacognition.

* Corresponding author.
E-mail address: jeortegama@unal.edu.co (J. Ortega).

https://doi.org/10.1016/j.concog.2018.08.008
Received 2 April 2018; Received in revised form 23 August 2018; Accepted 25 August 2018

There has been much research investigating metacognition in learning and memory, yet little is known about metacognition of perception (Levin, 2004). Understanding biases and errors in visual metacognition has important implications for the way we judge ourselves and others in real-world scenarios (e.g., eye witness testimonies, road safety litigations, perceptual errors in radiology). Whilst there is a large literature addressing cognitive failures that undermine real-life phenomena, much less is known about the metacognitive failures involved. Levin et al. (2000) have shown that failures in metacognition are particularly prominent in visual short-term memory. In their study, the experimenter described four scenarios after which participants were asked if they would notice the changes that took place. The majority of subjects reported that they would notice the changes, yet previous experiments revealed that most were missed (Levin & Simons, 1997; Simons and Levin, 1998). The discrepancy between what participants believed they would notice and the actual detection rates shows that people overestimate their change-detection ability; the same pattern of results was found when participants were asked about other people's change detection abilities. Levin et al. (2000) suggest several explanations for why change blindness blindness (CBB) occurs. For example, people may think that salient stimuli will capture their attention automatically, and situations in which they successfully detect changes might lead them to overestimate their change-detection ability.

Beck et al. (2007a) showed that people were less susceptible to change blindness when they were told to look for changes, but they still failed to understand that directing attention intentionally improves their performance. Smilek, Eastwood, Reynolds and Kingstone (2007) criticized this study based on the fact that individuals rarely experience radical changes to stable and unchanging objects. Indeed, they found that people's predictions are often better when the examples relate to real life situations in which they have personal experience (e.g., driving). However, Beck, Levin, and Angelone (2007b) argued that in real life, objects often change locations (e.g., a saltshaker is replaced with a spoon). In addition, people also exhibit inattentional blindness blindness (IBB). Levin and Angelone (2008) found that 88% of subjects predicted detecting the gorilla as opposed to the 42% that actually detected it in Simons and Chabris (1999).

Other studies on visual metacognition have examined subjects' meta-attentional errors. The findings from these investigations are relevant because traditionally it has been claimed that attention is necessary for conscious visual awareness (Cohen, Cavanagh, Chun, & Nakayama, 2012). Kawahara (2010) asked participants to look at pictures and use a pen to delineate the shape(s) of their immediate attentional focus (foci). Subjects believed that they could divide their attentional spotlight and that it covered larger areas than those reported in laboratory studies. Moreover, a subsequent experiment revealed that participants were unable to direct their focus of attention to two opposite locations at the same time, which suggests that people have inaccurate intuitions about their ability to distribute attention over space.

Overt attentional processes are determined by where we look, and most of our eye movements are driven by unconscious processes. Consequently, we rarely reflect on where we look. However, there is evidence to suggest that we do have some insights into where we have looked in the past. A question that arises is whether participants' reports on where they look indicate that they remember their scanpaths. Several studies have addressed this issue (Foulsham & Kingstone, 2013; Marti, Bayet, & Dehaene, 2015; Võ, Aizenman, & Wolfe, 2016). Võ et al. (2016) remark that information about fixations is not useful for most daily life activities, although it might be important for tasks where visual scrutiny is necessary such as scanning a medical image. Foulsham and Kingstone (2013) conducted several experiments to examine whether observers can recognize their own fixations. Participants viewed a series of natural scenes and their fixations were recorded using an eye tracker. They were asked to discriminate their fixation patterns from representations that corresponded to random patterns of fixations, fixations they made while viewing a different scene, and fixations made by another observer. Participants were able to discriminate between their scanpaths and a random pattern with an accuracy better than chance. However, their accuracy dropped when they had to distinguish their scanpaths from fixations they made while viewing a different scene and fixations made by another observer. It is not clear from these findings whether participants remembered where they looked or remembered the objects in the scene and therefore inferred that they looked at them.

Marti et al. (2015) examined whether subjects could report the fixations they made during a serial search task. Participants were asked to report the sequence of their eye fixations using mouse clicks and their reports were compared to recorded eye movements. The results suggested that they could introspect about their eye fixations to some extent. However, some of the actual fixations were not reported, and participants reported fixations that never occured. Marti et al. (2015) hypothesize that false reports indicate introspection of covert attentional shifts. Võ et al. (2016) ran two experiments using natural and artificial scenes. Participants were instructed to indicate where they looked and to guess where someone else would look by clicking on the scenes. To discourage participants from deliberately trying to encode their fixations, they were instructed to indicate where they looked by clicking on the scenes in only 25% of the trials. To measure memory for fixations, Võ et al. (2016) calculated the overlap between participants' actual fixations and their clicks. They compared this measure with the overlap that would be produced by an ideal observer who has a perfect memory for fixations. Participants' estimates of their own and someone else's fixations were better than chance but far from an ideal observer's estimate, and their performance was worse using artificial scenes. These studies suggest that observers have intuitions about where they look, although there is no compelling evidence that they can actually remember their scanpaths.

Overall, studies on CBB, IBB and meta-attention reveal counterintuitive limitations in cognition. Another example of a counterintuitive experimental finding is that people can fail to perceive a salient unexpected stimulus, even when they look at it (Beanland & Pammer, 2010; Memmert, 2006). The reason why this finding is counterintuitive is because we typically make voluntary eye movements towards a stimulus that is relevant to us, and in doing so we get a more detailed image of the area. Therefore, our intuition tells us that we should be able to consciously perceive an object that we are looking at. In many tasks, such as reading, it is essential to fixate the appropriate position in the word, to ensure that each letter can be perceived. In many everyday tasks, such as making a cup of tea (Land, Mennie, & Rusted, 1999) or a sandwich (Hayhoe, Shrivastava, Mruczek, & Pelz, 2003), our eyes fixate the