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Attentional processes and meditation

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ABSTRACT

Visual attentional processing was examined in adult meditators and non-meditators on behavioral measures of change blindness, concentration, perspective-shifting, selective attention, and sustained inattentional blindness. Results showed that meditators (1) noticed more changes in flickering scenes and noticed them more quickly, (2) counted more accurately in a challenging concentration task, (3) identified a greater number of alternative perspectives in multiple perspectives images, and (4) showed less interference from invalid cues in a visual selective attention task, but (5) did not differ on a measure of sustained inattentional blindness. Together, results show that regular meditation is associated with more accurate, efficient, and flexible visual attentional processing across diverse tasks that have high face validity outside of the laboratory. Furthermore, effects were assessed in a context separate from actual meditation practice, suggesting that meditators' better visual attention is not just immediate, but extends to contexts separate from meditation practice.

1. Introduction

In everyday life, humans function as though visually perceived stimuli represent veridical external reality. However, among psychologists it is widely accepted that perception is constructed both from bottom-up (or sensory) and top-down (or cognitive) processes (e.g., Brewer & Loschky, 2005; Long & Toppino, 2004). Furthermore, much research shows that top-down or cognitive factors influence what we actually see in visual perception (e.g., Balcetis & Dale, 2003; Bhalla & Proffitt, 1999; Proffitt, Creem, & Zosh, 2001; Ruz & Nobre, 2008). One top-down process that influences basic visual perception is self-related beliefs. Specifically, Balcetis and Dunning (2006) investigated in five studies how the motivation to think favorably of one's future outcomes influences visual perception. They demonstrated that experimentally manipulated self-related motivational states caused individuals to perceive ambiguous visual stimuli in directions that would accrue favorable outcomes for themselves. Moreover, Study 5 ruled out conscious deception as an explanation, allowing the authors to conclude that self-related motivation biases visual perception at the preconscious level.

Given that self-related constructs can bias visual perception, individual differences in self-functioning also might systematically influence perception, but this has not been widely examined. The current study investigated perception as a function of meditation practice. Gradual de-construction of self-related beliefs is at the core of Buddhist practice (Loori, 1992; Trungpa, 1995); hence, over time, effective meditation should lessen the tenacity of self-related motivational states. To the extent that meditation lessens self-absorption, perceptual bias associated with self-related motivation (e.g., Balcetis & Dunning, 2006) also might be reduced.

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An alternative second pathway by which meditation could decrease visual perceptual bias is even more direct and concrete. Although meditation techniques differ (Lutz, Slagter, Dunne, & Davidson, 2008), they have in common the monitoring and regulation of attention, which is central to visual perception. Thus, meditation could improve perception quite directly, by heightening attentional processes, and also indirectly, by altering the self-functioning that contributes to perceptual bias. The current study examined the hypothesis that meditation is associated with superior visual perception, without distinguishing between the two possible mechanisms.

Some past evidence supports that meditation benefits visual perception. For example, intensive short-term meditation training improves stimulus detection (Brown, Forte, & Dysart, 1984), long-term Zen meditators show less Poggendorff visual illusion than novice and non-meditators (Tloczynski, Santucci, & Astor-Stetson, 2000), experienced meditators show greater improvement in stimulus detection during intensive retreat relative to new and non-meditators (Jha, Krompinger, & Baime, 2007), and those who focus on visual images during deity meditation have better mental imagery immediately afterward relative to non-meditators and meditators who use non-deity meditation techniques (Kozhevnikov, Louchakova, Josipovic, & Motes, 2009). Meditation also enhances specific attentional measures; for example, it improves short-term attention switching (Chambers, Lo, Allen, & Allen, 2008;), decreases Stroop interference and improves concentration (Moore & Malinowski, 2009), changes brain-resource allocation, reducing the "attentional-blink" refractory period (Slagter et al., 2007), and is associated with the absence of expected age-related increases in attentional blink (van Leeuwen, Muller, & Melloni, 2009).

The conclusions allowed by the previous research are limited, however. Many of the above studies examined perception during or immediately after meditation (e.g., Chambers et al., 2008; Jha et al., 2007; Kozhevnikov et al., 2009; Slagter et al., 2007). Hence, whether improvement is sustained beyond the immediate context of meditation practice remains unclear. Most studies examine only one or two measures, sometimes even using paper and pencil tests of perception (e.g., Moore & Malinowski, 2009), which are less precise and valid than reaction-time measures. Moreover, many studies use simple visual stimuli such as dots of light (e.g., Jha et al., 2007; Slagter et al., 2007), and the relation of such simple stimuli to naturalistic perception has not been established. Thus, the relation of meditation practice to complex visual perception such as that in natural settings is not well-established empirically. Other previous studies are methodologically limited due to small sample sizes (e.g., Kozhevnikov et al., 2009) or the failure to report sample size clearly (Jha et al., 2007). Hence, questions remain about the relation of meditation practice to visual attention and perception.

The current study assessed visual perception more comprehensively than many previous studies by including four previously validated reaction-time measures of visual perception. Three tasks have excellent face validity as measures of naturalistic attentional processing, which increases our confidence that results generalize to real-life perceptual processing. We examined the effect of an individual difference on visual processing by including meditators and age-matched non-meditators, and used a larger sample than many past studies ($N = 96$). We also tested participants in a context removed from the immediate practice of meditation. That is, participants did not meditate before completing tasks, which allowed us to examine whether regular practice is associated with better visual perception "off the cushion", i.e., in everyday functioning, rather than during meditation. We hypothesized that it would be, and that regular meditators would show more efficient and flexible processing of visual stimuli as assessed by all measures. Hence, the unique contributions of the current study include that it (1) examined diverse aspects of visual attentional processing (change blindness, sustained inattentional blindness, visual concentration, perspective-shifting, and selective attention), (2) included three previously validated tasks with high external validity, (3) examined the relation of an individual difference (meditation practice) to visual processing, and (4) tested participants in a context separate from meditation, so that results reflect stable differences rather than immediate and possibly brief effects of meditation practice.

One visual task assessed change blindness, which is the failure to detect large changes to objects or scenes (Simons & Levin, 1998). Change blindness is common and typically assessed with two versions of a static display that contain peripheral or non-distinctive changes presented with an interruption (Koivisto & Revonsuo, 2008; Simons & Ambinder, 2005). Little is known about individual differences, although situational effects in change blindness have been noted. For example, change blindness is reduced among domain-specific experts; for example, changes in football scenes are better detected by football experts (Werner & Thies, 2000). Consistent with this, participants show less change blindness when stimuli are personally socially relevant (Bracco & Chiorri, 2009).

We measured change blindness with the previously validated 'flickering task' which alternates between two versions of static stimuli representing real-life situations (Rensink, O'Regan, & Clark, 1997). The scenes are unrelated to meditation, thus, differences in performance between meditators and non-meditators cannot be a function of expertise or social relevance demonstrated in previous research. Rather, any relation of meditation and flickering task performance would reveal general change blindness. To our knowledge this is the first study to examine the relation of an individual difference to change blindness.

Inattention that is even more pronounced is demonstrated in studies of sustained inattentional blindness, which refers to the failure to notice unexpected changes when attention is directed elsewhere (Most, Scholl, Clifford, & Simons, 2005). Sustained inattentional blindness differs from change blindness in its use of dynamic displays rather than static stimuli, and in its use of attentional sets. The most well-known measure is the gorilla video (Simons & Chabris, 1999) in which three white-shirted persons bounce basketballs as they circle among three black-shirted persons, who are bouncing balls and circling in the opposite direction. A woman dressed in a black gorilla costume enters the circle from the right, pounds her chest, and exits left. A high percentage of viewers fail to notice the gorilla, especially with an attentional set directing them away from the black gorilla, such as monitoring white-shirted players.