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Brief mindfulness induction reduces inattentional blindness

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ABSTRACT

Prior research has linked mindfulness to improvements in attention, and suggested that the effects of mindfulness are particularly pronounced when individuals are cognitively depleted or stressed. Yet, no studies have tested whether mindfulness improves declarative awareness of unexpected stimuli in goal-directed tasks. Participants ($N = 794$) were either depleted (or not) and subsequently underwent a brief mindfulness induction (or not). They then completed an inattentional blindness task during which an unexpected distractor appeared on the computer monitor. This task was used to assess declarative conscious awareness of the unexpected distractor's presence and the extent to which its perceptual properties were encoded. Mindfulness increased awareness of the unexpected distractor (i.e., reduced rates of inattentional blindness). Contrary to predictions, no mindfulness × depletion interaction emerged. Depletion however, increased perceptual encoding of the distractor. These results suggest that mindfulness may foster awareness of unexpected stimuli (i.e., reduce inattentional blindness).

1. Introduction

People are often unaware of what is visible before them. For example, a classic study found that when participants were asked to count passes between basketball players, many participants failed to notice a person in a gorilla suit walking through the middle of the game (Simons & Chabris, 1999). Such failures of declarative awareness are termed inattentional blindness (IB) (Mack & Rock, 1998; Simons & Chabris, 1999). IB frequently occurs when unexpected stimuli appear during goal-directed tasks. These failures of visual awareness have important real-world consequences. For instance, many participants failed to notice a physical assault occurring nearby (Chabris, Weinberger, Fontaine, & Simons, 2011); oncoming motorcycles (Most & Astur, 2007); and airplanes parked across the runway during simulations (Haines, 1991). Despite these effects, very little research has considered what an individual may be able to do to reduce the risk of IB.

One candidate protective factor may be presence of a mindful state. Mindfulness is the capacity to monitor sensory and perceptual stimuli and experiences, moment-by-moment in a non-judgmental manner (Bishop et al., 2004; Kabat-Zinn, 2003). Mindfulness can be induced or trained using simple awareness exercises (e.g., mindfully eating raisins), mindfulness meditation practices, and intervention programs (e.g., the 8-week Mindfulness-Based Stress Reduction [MBSR] program) (Brown, Ryan, & Creswell, 2007). One central feature of these mindfulness-enhancing practices is their focus on fostering greater attention to and awareness toward ongoing sensory and perceptual stimuli and experiences. The focus on developing

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capacity for non-judgmental monitoring of experience, helps to differentiate mindfulness from other forms of attention training (Lutz, Slagter, Dunne, & Davidson, 2008). Indeed, recent studies suggest that a capacity to monitor internal and external experience during mindfulness meditation training improves behavioral measures of attention (Jha, Krompinger, & Baime, 2007; Moore, Gruber, Derose, & Malinowski, 2012; Tang et al., 2007).[1] It is also possible that these mindfulness exercises, particularly the briefer inductions, may enhance attentional abilities relative to passive control conditions via instructions to attend to and engage with the tasks. Yet, no studies have tested whether a brief mindfulness induction fosters greater awareness of unexpected stimuli in IB tasks. Here we test the novel prediction that a brief mindfulness exercise can reduce IB.

This novel prediction is consistent with work in other paradigms; namely the change blindness and visual search paradigms. In change blindness paradigms, a characteristic of a stimulus changes (or the stimulus itself changes) and participants are tasked with detecting this change. Change detection is facilitated when participants adopt the passive search strategy of letting the distractor "pop out" (Smilek, Enns, Eastwood, & Merikle, 2006) and among those from cultural and employment backgrounds that promote bottom-up search (e.g., Asano, Kanaya, & Yokosawa, 2008; Masuda & Nisbett, 2006). Conceptually, such bottom-up search strategies are consistent with the monitoring processes fostered by mindfulness inductions. Comparably, posthypnotic suggestion of similar bottom-up search strategies improves the speed with which participants can detect a target among an array of distractors (Lifshitz, Bonn, Fischer, Kashem, & Raz, 2013). What differentiates these detection effects from the postulated effect of mindfulness on IB is that IB is focused on the detection of *unexpected distractors* rather than expected targets.

A growing body of research shows that mindfulness (and mindfulness-based training interventions) broadly have larger effects in cognitively depleted or stressed populations (Creswell, 2014; Friese, Messner, & Schaffner, 2012). Cognitive (or "ego") depletion refers to a meta-analytically supported (Hagger, Wood, Stiff, & Chatzisarantis, 2010) finding that having recently performed an act of self-regulation (typically acts requiring response inhibition) temporarily impairs subsequent self-regulation (Baumeister, Bratslavsky, Muraven, & Tice, 1998). In one illustration of a mindfulness × depletion interaction, Friese et al. (2012) found that the depleting effect of suppressing emotions on subsequent self-regulation was buffered by brief mindfulness meditation. Cognitive depletion also reduces working memory capacity (Hofmann, Schmeichel, & Baddeley, 2012), and mindfulness buffers working memory declines during cognitively demanding boot camp training periods in soldiers (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010). Similarly, mindfulness also reduces biological stress reactivity in high (but not low) stress conditions (Arch & Craske, 2010; Brown, Weinstein, & Creswell, 2012). One possibility raised by this depletion account is that mindfulness may not always reduce IB, but rather mindfulness will only reduce IB in participants whom are cognitively depleted or stressed (a depletion × mindfulness interaction). To evaluate this possible interaction account, we experimentally manipulated depletion prior to having participants complete a brief mindfulness induction in the present study.

The present study thus manipulated self-regulatory depletion (depletion writing, neutral writing, no-writing) and mindfulness (mindfulness induction, control) in a 3 × 2 between-participants factorial design in a large sample of adults ($N = 794$). Using previously validated procedures for self-regulatory depletion (Schmeichel, 2007), participants were instructed to complete a cognitively demanding writing task (depletion condition), an easy writing task (writing control condition), or no writing (no-writing control). Participants then completed either a short audio-guided mindfulness exercise (mindfully eating raisins) or an audio-listening task (hearing factual information about raisins). This exercise was selected as the brief mindfulness induction because this raisin eating exercise is commonly used as the first training exercise in mindfulness meditation training intervention studies (e.g., MBSR) (Kabat-Zinn, 1982, 1990), and successfully induces a mindful state when used as a standalone induction in meditation novices (Heppner et al., 2008).

After completing the mindfulness induction manipulation, participants completed a standard IB task (Most et al., 2001; Simons, 2003). This task consists of counting the number of times a subset of moving black or white letters touches the edge of the computer screen. During the task, a bright red plus symbol moves across the screen. Experiments have found 25–50% of individuals failed to notice the unexpected red plus symbol when tracking the white subset of letters and ignoring the black ones (Hannon & Richards, 2010; Most et al., 2001). IB was assessed using standard procedures: participants were probed on whether they detected something unusual or unexpected (or not), and to indicate what they observed.

A person may identify the distractor because it was red or because it was a plus symbol, while being fully unaware of its other unique feature(s). As such, it is possible for a person who is aware of the distractor's presence to have reported the distractor without having fully encoded its features. In fact, behavioral and neuroimaging work suggests that the distractor undergoes equivalent perceptual encoding independent of whether the participant experiences IB or not (Butler & Klein, 2009; Vandenbroucke, Fahrenfort, Sligte, & Lamme, 2013). In light of this, a secondary measure of depth-of-distractor processing was included to examine whether full encoding of the distractor had taken place (cf. Swettenham et al., 2014; Vandenbroucke et al., 2013), and whether mindfulness would influence full encoding of the unexpected distractor.

We predicted: (1) a main effect of a mindfulness induction on reducing IB such that those in the mindfulness condition would be more likely to report the unexpected distractor during the task; and that (2) this main effect would be qualified by a mindfulness × depletion interaction, such that the induction of mindfulness would reduce IB among depleted individuals, but mindfulness would have no effect on IB among those in the non-depleted conditions. We remained neutral as to whether the effects of mindfulness and depletion on distractor encoding would mirror declarative distractor awareness (i.e., be

[1] Tang et al. (2007) made use of integrative body-mind training which included a mindfulness meditation element.

increased), be absent, or even diverge from declarative awareness, given that declarative awareness is dissociable from attention and encoding (Butler & Klein, 2009; Vandenbroucke et al., 2013).

2. Method

2.1. Participants

The sample consisted of 794 introductory psychology students who completed the experimental tasks on classroom computers, as part of an in-class activity (512 women, M_{age} = 19.64 years, *SD* = 3.24). All prospective participants were informed that the in-class activity was optional and that they could elect to sit quietly. Interested participants provided informed consent and all study procedures were approved by the UNSW Ethics Committee. Participants in each testing session (up to 28 students) were randomly assigned to the same condition, yielding 41 classrooms, with 6–7 classrooms in each condition, in a 3 (depletion writing, neutral writing, no-writing) × 2 (mindfulness induction, control) between-participants factorial design.

2.2. Materials and procedure

Participants completed a three-phase study on cognitive abilities – which manipulated self-regulatory depletion, then mindfulness, and then measured IB using a standardized task. Participants in the depletion condition completed a difficult 10-min writing task in which they described the university campus, without using words containing the letters A or N (Schmeichel, 2007). Relative to writing freely, this depleting writing task is rated as more difficult (Carter & McCullough, 2013; Schmeichel, 2007; Schmeichel, Harmon-Jones, & Harmon-Jones, 2010), more strenuous (Pohl, Erdfelder, Hilbig, Liebke, & Stahlberg, 2013) and as requiring more effort (Schmeichel & Vohs, 2009). There were two control conditions: a neutral writing condition without depleting instructions and a no-writing task. Two control conditions were used in order to rigorously evaluate whether depletion had an appreciable main effect on IB compared to an active neutral writing and to a no-writing control task.

Participants then either participated in an audio-guided mindfulness exercise using raisins or listened to an informative factual description of raisins (control condition). This active attention control condition was implemented (as opposed to a passive rest period) to control for attentional engagement and exposure to potentially appetitive raisin content (for other examples of studies using active listening comparison condition, see Allen et al., 2012; Creswell, Pacilio, Lindsay, & Brown, 2014; Zeidan et al., 2011). The audio recordings in both conditions used the same female speaker and cadence. In the mindfulness condition, participants were guided in mindfully attending to the experience of smelling, observing, feeling, tasting, and consuming several raisins during a 7-min period. Critically, participants were instructed to openly attend to and experience whatever was present in their sensory experience of the raisins, following general procedures used in the MBSR program (Kabat-Zinn, 1990). Participants in the control condition received interesting factual information about raisins for 6 min and were informed that their memory for this information would not be tested (e.g., "dried grapes are also one of the top sources of the trace mineral boron").

After completing the two experimental manipulations, participants then completed an IB task. In this task (see Most et al., 2001), four black and four white "L" and "T" characters moved around the screen. Participants were asked to count the number of times the white letters bounced off the edge of the screen. During this task an unexpected red "+" symbol moved from right to left across the screen's center. Upon completion of the task, participants reported the number of bounces. Following Hannon and Richards (2010), we considered accurate counts to be 12 ± 1 bounces. Next, participants were probed on whether they saw "anything unusual or unexpected during the task?" If they said yes, they were asked to report what they had seen by typing in their response. IB was thus a dichotomous variable (yes, no) and was *not* considered to occur if (1) the participant reported the presence of an unexpected event during the task, *and* (2) accurately reported at least one feature of the unexpected distractor stimulus ("+") during the task (i.e., shape, color, onset, motion path).

For the secondary measure of distractor processing, participants were presented with one of 4 randomly arranged 2 × 3 arrays of red and green, "L", "T" and "+" characters, and asked if they had seen any of these shapes. If they had, they were instructed to select what they had seen from the array.[2] This array-based identification procedure allowed assessment of whether *full encoding* of the distractor had taken place.

2.3. Analysis plan

All analyses were conducted using hierarchical logistic regression analyses with main effects fitted at step 1 and interactions at step 2. Omnibus tests of the depletion factor and its interactions were followed up with planned orthogonal contrasts comparing the two control conditions to each other and their average to the depletion condition to test the *depletion* effect. In

[2] A forced-choice iteration of this probe was then presented to participants to allow exploratory analysis of distractor processing in those who claimed not to have seen any stimulus in the array. These participants were above chance (test value: 0.167) at identifying the distractor in the forced choice array, $t(65) = 2.16$, $p = .035$, $M_D = 0.12$, suggesting that perceptual processing was taking place in the absence of awareness.

addition to significance values, the odds ratio (*OR*), its 95% confidence interval, and Cohen's *d* are reported (*d* was calculated using Borenstein, Hedges, Higgins, and Rothstein (2011): $d = ln(OR) \times \frac{\sqrt{3}}{\pi}$.

2.4. Power

Assuming a base rate of conscious distractor detection at 60% and unbiased allocation to conditions, the power to detect a medium sized main effect (*OR* = 2.47, equivalent to *d* = 0.5) of mindfulness on distractor detection was 100% (Hypothesis 1); the power to detect a medium sized mindfulness × depletion interaction on distractor detection was 76% (Hypothesis 2) (Hsieh, Bloch, & Larsen, 1998).

3. Results

3.1. Preliminary analyses

Across conditions there were no significant differences in the proportion of female participants, $\chi^2(5, N = 794) = 4.73$, $p = .45$, liking of raisins, $F(5, 786) = 0.54$, $p = .75$, or the distribution of White (38.3%), East Asian (28.1%), South Asian (15.0%), and Other (18.6%) ethnicities, $\chi^2(15, N = 794) = 18.90$, $p = .22$. Age, however, differed marginally across conditions, $F(5, 788) = 2.20$, $p = .05$, and was used as a covariate in all analyses. Including age as a covariate did not appreciably alter any of the study results.

No differences emerged between conditions for count accuracy main effects, contrasts or the interaction, all $ps \geqslant .24$ (see Table 1). Prior research indicates that better primary task performance is often associated with greater levels of inattentional blindness (Cartwright-Finch & Lavie, 2007; Simons & Chabris, 1999; Simons & Jensen, 2009). Although in this direction, counting accuracy was not robustly associated with a lower probability of detecting the distractor, *OR* = 0.84 (*95% CI*: 0.63, 1.13), *p* = .25, *d* = 0.10, controlling for counting accuracy does not change any of the reported IB results. Counting accuracy was not associated with distractor encoding either before, *OR* = 0.79 (*95% CI*: 0.59, 1.06), *p* = .12, *d* = 0.13, or after, *OR* = 0.82 (*95% CI*: 0.59, 1.15), *p* = .25, *d* = 0.11, controlling for distractor detection. Moreover, controlling for counting accuracy does not change any of the reported distractor encoding results.

3.2. Main analyses: inattentional blindness

We predicted that the induction of mindfulness would reduce IB, and that this effect would be qualified by an interaction with self-regulatory depletion. Estimated marginal means are presented in Fig. 1, with unadjusted means in Table 1. Consistent with our first prediction, the hierarchical logistic regression indicated a significant main effect of mindfulness condition on IB. Specifically, participants in the mindfulness condition were less likely to experience IB, as indicated by greater rates of distractor detection, than those in the control condition, *OR* = 1.41 (*95% CI*: 1.05, 1.89), *p* = .02, *d* = 0.19. This effect indicates that a brief mindfulness induction fostered greater declarative awareness of the unexpected "+" stimulus during the task. Notably, this hierarchical logistic regression analysis also showed that participants in the depletion condition were no more likely to notice the distractor than those in the control conditions, *OR* = 0.99 (*95% CI*: 0.73, 1.35), *p* = .95, *d* = 0.01, and that there were no differences between the control conditions, *OR* = 0.73 (*95% CI*: 0.51, 1.04), *p* = .08, *d* = 0.17.[3] Contrary to predictions, there was no significant depletion (i.e., depletion vs. the two control depletion conditions contrast) × mindfulness condition interaction, *OR* = 1.26 (*95% CI*: 0.67, 2.35), *p* = .47, *d* = 0.12.[4]

3.3. Distractor encoding

Only 81.2% of participants who were aware of the distractor showed evidence of having fully encoded the distractor by selecting it from the lineup, whereas 31.6% of inattentionally blind participants showed evidence of full encoding. Estimated marginal means of full encoding are presented in Fig. 2, with unadjusted means in Table 1. Despite mindfulness improving distractor awareness in the primary IB analysis, mindfulness had no main effect on line-up identifications indicative of full encoding of the distractor, *OR* = 1.24 (*95% CI*: 0.93, 1.66), *p* = .15, *d* = 0.12. Any apparent effect appeared attributable to the effect of mindfulness on distractor awareness, as when distractor awareness was additionally controlled this non-significant effect was even smaller in magnitude, *OR* = 1.07 (*95% CI*: 0.76, 1.49), *p* = .71, *d* = 0.04. By contrast, despite depletion not affecting distractor detection (i.e., IB), depleted participants were significantly more likely to have fully encoded the unexpected distractor than those who were not depleted, *OR* = 1.50 (*95% CI*: 1.09, 2.05), *p* = .01, *d* = 0.22, and there was no difference between the two no-depletion conditions, *OR* = 0.88 (*95% CI*: 0.62, 1.23), *p* = .47, *d* = 0.07. When distractor detection was accounted for, these patterns of significant and non-significant differences became more extreme: depletion vs.

[3] There was also no significant effect of writing (depletion writing, neutral writing vs. no-writing), *OR* = 1.28 (*95% CI*: 0.93, 1.75), *p* = .13, *d* = 0.14.

[4] There was also no significant interaction of mindfulness with writing on inattentional blindness, *OR* = 0.79 (*95% CI*: 0.42, 1.48), *p* = .46, *d* = 0.13.

Table 1
Dependent measure descriptive statistics for each condition.

Condition	*N*	Accurate counters (%)	Aware of the distractor (%)	Full encoding of the distractor (%)
Facts & no writing control	120	49.17	65.83	64.17
Facts & control writing task	133	51.88	55.64	54.89
Facts & depleting writing task	134	57.46	58.21	64.18
Mindfulness & no writing control	145	46.90	69.66	60.69
Mindfulness & control writing task	139	52.52	64.03	61.87
Mindfulness & depleting writing task	123	48.78	69.11	74.80

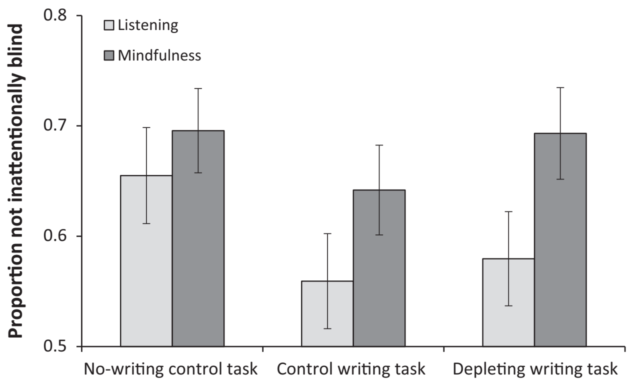

Fig. 1. Distractor awareness. A main effect of mindfulness emerged such that there were more people aware of the unexpected distractor in the mindfulness than the listening condition. There was no main effect of depletion or a mindfulness × depletion interaction on distractor awareness. Plotted are estimated marginal means controlling for age, with error bars presenting ±1 standard error approximated via the delta method.

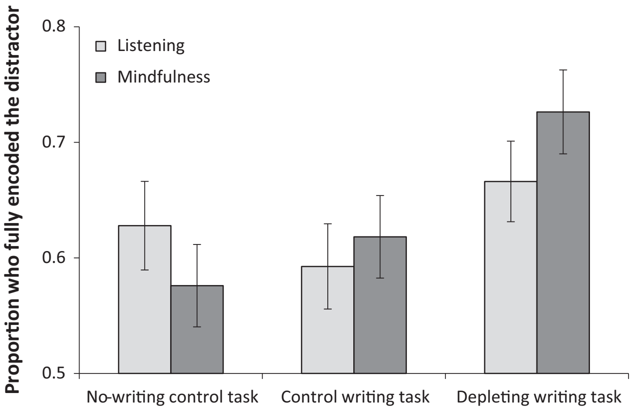

Fig. 2. Distractor encoding. Participants who completed the depleting writing task were more likely to have fully encoded the distractor than those in either control condition. There was no effect of mindfulness on distractor encoding, nor any interaction between mindfulness and depletion. Plotted are estimated marginal means controlling for age and conscious detection with error bars presenting ±1 standard error approximated via the delta method.

control conditions comparison, *OR* = 1.71 (*95% CI*: 1.19, 2.47), $p < .01$, $d = 0.30$; no-depletion conditions comparison, *OR* = 1.04 (*95% CI*: 0.69, 1.55), $p = .86$, $d = 0.02$.[5]

Continuing to control for conscious detection, no significant interaction between depletion and mindfulness occurred, *OR* = 1.56 (*95% CI*: 0.75, 3.27), $p = .23$, $d = 0.25$, nor was there any differential effect of mindfulness on the two control conditions, *OR* = 1.54 (*95% CI*: 0.69, 3.45), $p = .29$, $d = 0.24$.[6] Furthermore, non-significant mindfulness × conscious detection, *OR* = 1.24 (*95% CI*: 0.63, 2.43), $p = .54$, $d = 0.12$, and depletion contrast × conscious detection interactions, *OR* = 1.13 (*95% CI*: 0.53, 2.39), $p = .75$, $d = 0.07$, ruled out the possibility of both mindfulness and depletion having different effects on full encoding for participants who did or did not experience IB.

[5] There was no evidence of a main effect of writing either before, *OR* = 0.90 (*95% CI*: 0.66, 1.23), $p = .51$, $d = 0.06$, or after, *OR* = 0.74 (*95% CI*: 0.52, 1.06), $p = .10$, $d = 0.16$, controlling for conscious detection.

[6] There was no significant interaction of mindfulness with writing on distractor encoding, *OR* = 0.58 (*95% CI*: 0.28, 1.17), $p = .13$, $d = 0.30$.

4. Discussion

Mindfulness reduced IB, suggesting that the induction of a brief mindful state facilitated the identification of an unexpected distractor. This experiment is the first to show that a brief induction of mindfulness reduces IB. This effect is consistent with recent theorizing about how mindfulness facilitates greater monitoring and awareness of one's sensory and perceptual experience (Lutz et al., 2008). The present data suggest that even brief guidance in how to monitor one's sensory and perceptual experiences of eating a raisin translated into greater conscious detection of an unexpected distractor during a subsequent task. Alternatively, this finding may be consistent with the possibility that mindfulness promoted active rather than passive attention. The precise mechanism may be elucidated with more nuanced mindfulness inductions that differentiate open-monitoring from focused attention (see Lutz et al., 2008). Regardless of the exact mechanism, this finding is important for the IB literature, as little is known about person-level factors that can prevent IB.

Attention and declarative awareness are dissociable (Dehaene, Changeux, Naccache, Sackur, & Sergent, 2006; Lamme, 2003; Moore & Egeth, 1997; Vandenbroucke et al., 2013; Watanabe et al., 2011). The present finding that mindfulness reduced IB offers a novel contribution to the mindfulness literature. This literature has primarily focused on how mindfulness enhances attentional *processes* rather than its effects on *conscious awareness* of unexpected stimuli. The effects observed here of a mindfulness induction on IB are distinct from prior demonstrated effects of mindfulness on attentional blink (Slagter et al., 2007). Although performance in IB and attentional blink tasks share a small amount of variance, where IB tasks make use of an unexpected distractor, attentional blink tasks make use of a second target stimulus (Beanland & Pammer, 2012). Specifically, our findings provide the first evidence that mindfulness fosters greater conscious visual awareness of unexpected distractors during a goal directed task (as indexed via identification of an unexpected distractor).

Although we observed a main effect of mindfulness on reducing IB, we did not observe any mindfulness $\times$ depletion interactions. Specifically, there was no evidence for mindfulness buffering the effects of depletion on IB, which might be predicted from previous studies in the mindfulness literature (Friese et al., 2012; Jha et al., 2010). Interestingly, depletion had its own effect on distractor processing independent of the mindfulness induction. Although depletion did not alter distractor awareness, it did increase the probability that the perceptual details of the distractor would be fully encoded. This finding is consistent with evidence that top-down attention control required to shift attention back to target stimuli is impaired by prior use (Nuechterlein, Parasuraman, & Jiang, 1983; Rosenberg, Noonan, DeGutis, & Esterman, 2013). To the extent that depletion prevented attention from being shifted back to the targets, this mental process may account for the increased distractor processing and encoding. Given the novelty of this finding, and the uncertainty of our predictions about distractor encoding, it will be important for future investigations into depletion increasing accurate distractor encoding to take place.

We used a brief mindfulness induction and its observed effect on IB was small. Longer-term training protocols (e.g., MBSR) rather than the brief state induction of mindfulness employed here may produce larger effects of mindfulness on conscious awareness of stimuli in the environment. Future research may also consider the mechanisms of this effect. One common cause of IB is the top-down tunings in working memory of the information processing system. The influence of these tunings is evidenced by findings that distractors that share features with targets are more likely to be detected than those which do not (Aimola Davies, Waterman, White, & Davies, 2013; Most, 2013; Most & Astur, 2007; Most et al., 2001; Simons & Chabris, 1999). Perhaps mindfulness prevents top-down information processing biases from guiding attention. If this is the case, then mindfulness should have a greater ability to reduce IB when the targets of the primary task are highly similar to the unexpected distractor. Focused attention training (e.g., transcendental meditation) – which promotes top-down information processing – may also reduce IB when the target and distractor are similar and share features, but induce IB for target-dissimilar distractors. In the language used by IB researchers (Most, Scholl, Clifford, & Simons, 2005), open-monitoring based mindfulness may reduce the effects of attentional-set on IB, but we postulate that focused attention training may exacerbate such effects.

5. Conclusions

Both the induction of a mindful state and depletion altered how a distractor was processed while engaged in a primary task. The principle findings are consistent with mindfulness increasing monitoring of the environment, and specifically implicate the fostering of greater conscious awareness. As a result of these findings, we suggest that simply characterizing mindfulness as improving attention may not do justice to the nuances of its effects. In the present study, these effects were confined to the process of consciously noticing the unexpected distractor, which was dissociable from extracting detailed information about the distractor. The effectiveness of mindfulness at reducing inattentional blindness, a phenomenon linked to collisions in driving simulations (Most & Astur, 2007), corroborates recent suggestions that mindfulness may improve driving behavior (Kaas, VanWormer, Mikulas, Legan, & Bumgarner, 2011). Future research should consider the applications of brief mindfulness interventions in driving contexts to increase the detection of unexpected collision risks.

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