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Short Communication

Stepping out of history: Mindfulness improves insight problem solving

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ABSTRACT

Insight problem solving is hindered by automated verbal–conceptual processes. Because mindfulness meditation training aims at "nonconceptual awareness" which involves a reduced influence of habitual verbal–conceptual processes on the interpretation of ongoing experience, mindfulness may facilitate insight problem solving. This hypothesis was examined across two studies (total $N = 157$). Participants in both studies completed a measure of trait mindfulness and a series of insight and noninsight problems. Further, participants in Study 2 completed measures of positive affect and a mindfulness or control training. The results indicated that (a) trait mindfulness predicts better insight but not noninsight problem solving (both studies), (b) this relation is maintained when controlling for positive affect (Study 2), (c) mindfulness training improves insight but not noninsight problem solving (Study 2) and (d) this improvement is partially mediated by state mindfulness (Study 2). These findings are the first to document a direct relation between mindfulness and creativity.

Inertia is the first law of history, as it is of physics.
Morris R. Cohen

1. Introduction

The phenomenon of memory compels humans to be historical beings. This confers the benefit of being able to use our experience to understand the present and to solve many problems that emerge in life. Because the world is complex and dynamic, however, experience can interfere with adaptation. We may become stuck in customary interpretations and habitual problem-solving strategies that no longer apply in a novel situation. As an aim of mindfulness[1] meditation training is to reduce the influence of habit on the way we interpret and act in the world, mindfulness may facilitate the solving of problems that require creative, nonhabitual responses. The current research was designed to examine this hypothesis.

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[1] By mindfulness, we are referring to the practice derived from Eastern traditions rather than as defined in the work of Ellen Langer, who similarly acknowledges the difference (Langer, 1989). Although both have implications for creativity, mindfulness in Langer's research centers around actively searching for distinctions in external stimuli in order to shift information processing from a passive mode to an active one (Langer, Bashnerr, & Chanowitz, 1985). In contrast, mindfulness from an Eastern perspective involves a nonjudgemental awareness of one's experience. The difference is one between thinking about something in a novel way (from Langer's perspective) and observing the fact that one is thinking (from a mindfulness meditation perspective).

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The benefits and costs of prior learning can be demonstrated by distinguishing between two general classes of problems. Noninsight problems are those which involve logic and can thus be solved through an incremental series of steps (Metcalfe, 1986). Past experience can assist in solving noninsight problems, as in applying prior learning in order to add a set of algebraic polynomials. In contrast, insight problems are those in which the use of past experience leads to an impasse, which can be resolved through restructuring the problem (Ohlsson, 1992). Because this restructuring (and solution) tends to appear suddenly in consciousness, it is experienced as an insight (an "Aha" moment). For example, if one is told that (a) a man and his son were in a car accident (b) the man died, (c) when the son was taken to the hospital, the surgeon exclaimed "that is my son!" and then asked who the surgeon is, one may come to an impasse. This impasse can be understood as resulting from prior learning experiences in which the concepts of *surgeon* and *male* became linked in an associative network. Consequently, *surgeon* automatically activates *male* and thus biases search strategies toward answers involving a male. A restructuring of the problem so that the influence of this incorrect assumption is lessened allows the solution of "his mother" to emerge.

This restructuring and the emergence of the creative response has been proposed to involve spreading activation in memory (Ohlsson, 1992). There is evidence that this process is impeded by verbal–conceptual processes (Schooler, Ohlsson, & Brooks, 1993). Thus, concepts derived from prior experience can prevent the solving of insight problems both because they bias the search strategies away from those which would lead to the solution and because the language-based aspect of concepts can block access to the outcomes of the nonverbal processes involved in yielding the solution.

Mindfulness represents a unique practice that may have potential in facilitating the creative responses needed for solving insight problems. Practitioners have described mindfulness as involving a "nonconceptual awareness" that "does not get hung up on ideas. . .or memories" but instead "just observes everything as if it was occurring for the first time" (Gunaratana, 2002, p. 140). That is, an aim of mindfulness is to limit the ability of automatically activated verbal–conceptual content derived from past experience to bias thought and behavior.

Research supports the idea that mindfulness training may reduce the influence of the past on present-moment experience. For example, an early study found that experienced meditators demonstrated less habituation to sounds that were presented repeatedly (Kasamatsu & Hirai, 1966). Additionally, just as verbal–conceptual processes derived from prior experience may lock an individual into a particular problem solving strategy, they may also lock an individual into a particular way of evaluating the self. Clinical studies have provided evidence for the ability of mindfulness training to shift the relation with mental content from one in which individuals identify with their verbal–conceptual evaluations (e.g., being worthless) derived from past experience to one in which these concepts are experienced as mental content that comes and goes and which does not reflect a truth about the self (Teasdale et al., 2002; Twohig, Hayes, & Masuda, 2006).

Although this analysis suggests that mindfulness may reduce the tendency of verbal–conceptual processes to block nonhabitual responses necessary for solving insight problems, there is scant research on this topic. A PsycINFO search[2] with the terms "creativity" and "mindfulness" or "meditation" yielded no empirical publications involving mindfulness meditation. The current research examined this topic.

2. Experiment 1

We hypothesized that trait mindful awareness would be correlated with insight problem solving but not noninsight problem solving. We assessed trait mindfulness with the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003). The MAAS is proposed to measure the tendency to be directly aware of mental experience in the present moment versus being enmeshed in that mental experience; for consciousness to be focused on the fact that one is thinking rather than on the content of one's thought.

2.1. Methods

2.1.1. Participants

Eighty-six (43 females) undergraduates completed the study for course credit.

2.1.2. Measures

2.1.2.1. Trait mindful awareness. Mindfulness was assessed with the MAAS (Brown & Ryan, 2003). This measure consists of 15 items (e.g., I find it difficult to stay focused on what's happening in the present; reverse-scored) using a 5-point Likert scale ($\alpha = .85$).

2.1.2.2. Problems. Insight problem solving was assessed with three items from Schooler et al. (1993), including the prisoner's rope problem, the antique coin problem, and the inverted steel pyramid problem. Insight problem solving was calculated as a sum of correct answers with a possible range of 0–3. Noninsight problem solving was assessed with two items from Schooler et al. (1993), including the card problem and the criminal problem. Noninsight problem solving was calculated as a sum of correct answers with a possible range of 0–2.

[2] Performed in September 2011.

2.1.3. Procedure

Participants were run in groups consisting of one to five participants seated in small rooms adjoining a larger central room. Participants first completed the MAAS and then the insight and noninsight problems, which were presented in a fixed order (insight, noninsight, insight, noninsight, insight) and were administered on paper questionnaires. The experimenter instructed participants when to start each problem and informed participants when 5 min had elapsed, at which point participants were to stop working on the problem and turn the sheet over if they had not already finished. The participants were in the experimenter's field of vision so that compliance with the timing instructions could be ensured. All participants completed working on all of the problems before the 5 min mark.

3. Results and discussion

Zero-order correlations supported our hypotheses that there would be a statistically significant relation between mindful awareness and insight problem solving, $r(86) = .25$, $p = .02$ and a nonsignificant relation between awareness and noninsight problem solving $r(86) = -.01$, $p = .93$. Further, a Williams's t-test (Williams, 1959) indicated that the correlation between mindfulness and insight problems was significantly stronger than between mindfulness and noninsight problems, $t(83) = 2.0$, $p < .05$.

These results suggest that trait mindful awareness contributes to the ability to solve problems requiring a creative response. However, the power to infer a causal relation in this study is restricted by (a) the bivariate relation between mindfulness and insight problem solving could be accounted for by a third variable such as positive affect, which is related both to mindful awareness (Brown & Ryan, 2003) and to creativity (Isen, Daubman, & Nowicki, 1987) and (b) it is well known that correlation between two variables is a necessary but not sufficient condition for determining linear causation. Study 2 was designed to address these two limitations by examining whether a correlation between trait mindful awareness and insight problem solving is accounted for by positive affect and by using an experimental design to examine whether mindfulness training would improve insight problem solving.

4. Experiment 2

We had the following hypotheses in Study 2: (1) trait mindful awareness would be correlated with insight problem solving but not noninsight problem solving, replicating Study 1, (2) trait mindful awareness would predict variance of insight problem solving beyond that accounted for by positive affect, (3) mindfulness training would improve performance on insight but not noninsight problem solving, and (4) if mindfulness training improved insight problem solving, this effect would be partially mediated by state mindfulness.

4.1. Methods

4.1.1. Participants

Seventy-one (48 males) undergraduates completed the study for course credit.

4.1.2. Measures

4.1.2.1. Problems. The same insight and noninsight problems from Study 1 were used in this study.

4.1.2.2. Trait mindful awareness. Mindfulness was assessed with the MAAS ($\alpha = .86$).

4.1.2.3. State mindful awareness. State mindful awareness was measured with an item from the MAAS (Brown & Ryan, 2003), 'At this moment (right now) I feel like I will rush through activities without being really attentive to them' on a 15-point Likert scale. The item is scored such that larger values represent greater state mindfulness.

4.1.2.4. Trait positive affect. Trait positive affect was assessed with the Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988). The measure assesses the experience of 10 positive (e.g., interested, active) feelings over the past month with a 5-point Likert scale ($\alpha = .87$).

4.1.2.5. State positive affect. The Self-assessment manikin (SAM; Bradley & Lang, 1994) was used to assess state affect by participants placing a mark on one of seven block figures whose facial features represent feeling states ranging from *Unhappy* to *Happy*. The SAM has demonstrated good validity with other self-report measures of affect (Bradley & Lang, 1994).

4.1.3. Procedure

Participants were run in groups consisting of one to five participants seated in private workstations. Participants first completed the MAAS and trait and state positive affect measures. Participants were then randomly assigned to either a mindfulness ($n = 35$) or control ($n = 36$) condition administered with 10-min audios used in previous research (Cropley, Ussher, & Charitou, 2007). The mindfulness audio consisted of instructions to bring awareness to sensations in the body

(the breath and other areas of the body) in a nonjudgmental way (i.e., to allow and accept any body sensations, including pain). The control audio consisted of a natural history text. After the audio, participants reported their state mindfulness and then completed the insight and noninsight problems, which were administered on the computer. There were no time limits for solving the problems. All components were administered with MediaLab software (Jarvis, 2000). Researchers were blind to experimental condition, as they were required only to start each session on MediaLab, after which the software automatically presented all tasks and audio trainings in the proper sequence.

5. Results and discussion

Our first hypothesis, that trait mindful awareness would predict performance on insight but not noninsight problem solving, was supported with a positive relation between mindful awareness and insight problem solving, $r(71) = .30$, $p = .01$ and a null relation between mindfulness and noninsight problem solving $r(71) = .01$, $p = .92$ (see Table 1). A William's t-test indicated that these correlations were statistically different, $t(68) = 2.03$, $p < .05$.

Our second hypothesis, that trait mindfulness would predict variance of insight problem solving over and above that accounted for by positive affect, was examined with a regression analysis of insight problem solving on the trait and state positive affect variables entered as Step 1 and mindful awareness entered as Step 2. The results indicated that even when controlling for positive affect and condition, mindfulness continued to predict insight problem solving, $t(67) = 2.47$, $p = .02$, $\beta = .29$.

Our third hypothesis, that brief mindfulness training would lead to better insight problem solving but not to better noninsight problem solving, was supported with ANOVA results that the mindfulness group demonstrated better performance on the insight problems $F(1,69) = 5.10$, $p = .03$ (mindfulness mean = 1.14, $SE = .12$, control mean = 0.75, $SE = .12$, and a Cohen's d of .53), but not on the noninsight problems $F(1,69) = 0.16$, $p = .69$ (mindfulness mean = 0.29, $SE = .08$, control mean = 0.33, $SE = .08$) (see Fig. 1). We examined whether this finding could be explained by group differences in trait mindfulness, but the nonsignificant difference between groups, $t(69) = -1.4$, $p = .17$, supports the inference of a causal relation between mindfulness training and creativity.

Our fourth hypothesis was that state mindfulness would partially mediate the relation between the mindfulness induction and insight problem solving. We followed the steps proposed by Baron and Kenny (1986) to establish mediation (see Fig. 2). First, a relation between the predictor and criterion variables was established with a regression analysis of insight problem solving on the Condition variable, $t(69) = 2.26$, $p = .03$. Second, a relation between the predictor and mediator was established with a regression analysis of state mindfulness on the Condition variable, $t(69) = 3.68$, $p = .0005$. Third, a relation between the mediator and criterion variables was established (while controlling for the predictor) with a regression of insight problem solving on the state mindfulness and Condition variables, $t(68) = 2.03$, $p = .047$. Fourth, the relation between the predictor and criterion variables must be significantly reduced. Using the same regression as for Step 3, the results indicated that the relation between the Condition variable and insight problem solving was no longer significant, $t(68) = 1.29$, $p = .20$. A Sobel test indicated that the magnitude of the relation was significantly reduced, $z = 1.97$, $p = .049$, indicating a partial mediation of the relation between Condition and insight problem solving variables.

The results provide further evidence for a relation between mindfulness and creativity by replicating the results of Study 1 and extending them with the findings that the relation between trait mindfulness and insight problem solving is not accounted for by positive affect, that mindfulness training improves insight problem solving, and that this effect is partially mediated by state mindfulness.

6. General discussion

Prior experience represented in verbal–conceptual content allows us to navigate through a world that would otherwise be experienced as a "blooming, buzzing confusion" (James, 1983). However, treating mental content as reality can obscure perception of the novel features of the physical environment. For example, verbal rules can reduce contact with important aspects of the environment such as changes in its likelihood to provide rewards (Hayes, Brownstein, Zettle, Rosenfarb, &

Table 1
Zero-order correlations between trait mindfulness, positive affect and insight and noninsight problem solving.

Measure	Study 1 ($N = 86$)		Study 2 ($N = 71$)			
	1	2	1	2	3	4
1. Mindful awareness	–		–			
2. Insight problems	.25*	–	.30*	–		
3. Noninsight problems	−.01	.25*	.01	.24*	–	
4. State positive affect			.11	.13	.10	–
5. Trait positive affect			.18	.04	−.27*	.18

* $p < .05$

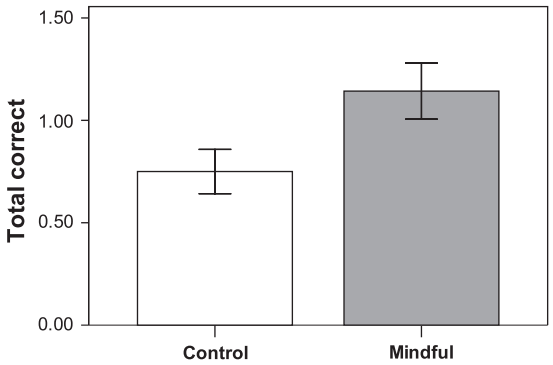

Fig. 1. Effects of mindfulness training on insight problem solving. Error bars represent ±1 *SE*.

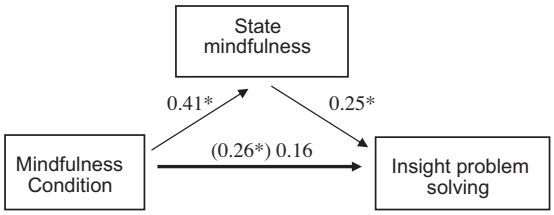

Fig. 2. Model of relation among Condition (0 = control, 1 = mindfulness), state mindfulness and insight problem solving. Values presented are standardized regression coefficients. The value in parentheses represents the coefficient for the direct (unmediated) path. $^{*}p < .05$.

Korn, 1986). Similarly, verbal–conceptual content derived from previous experience may hinder the solving of problems that require nonhabitual responses (Schooler et al., 1993). That is, yesterday's solutions may not apply to the problems of today.

Mindfulness has been proposed to reduce the influence of our past on interpreting and acting in the present. This is reflected in descriptions of mindfulness as involving "beginner's mind" or "bare attention" (Gunaratana, 2002). The current research supports this perspective. In both studies, individuals with greater trait mindful awareness were better able to solve insight problems, which requires overcoming habitual responses derived from prior experience. In addition, trait mindfulness was unrelated to performance in solving noninsight problems, which do not require the overcoming of habitual responses. Both of these findings were replicated in an experimental design (Study 2) in which participants were administered a mindfulness or control training. This experimental design provides important evidence for inferring a causal relation between mindfulness and creativity. Evidence that something specific to mindfulness is involved in insight problem solving is provided by the Study 2 findings that trait mindfulness continued to predict insight problem solving when controlling for the contribution of positive affect and that state mindfulness partially mediated the influence of mindfulness training on insight problem solving.

To the best of our knowledge, these findings are the first to demonstrate a direct relation between mindfulness and creativity. Future work is necessary to establish the mechanisms through which mindfulness may increase insight problem solving. For example, mindfulness may facilitate insight problem solving through: (1) decentering from the mind's concepts, which may reduce the tendency of search strategies to be constrained by prior experience, (2) facilitating awareness of the products of nonverbal processes involved in the necessary restructuring of the problem (Schooler et al., 1993), (3) some combination of both or (4) other processes.

Nietzsche (1957) observed that too much history (knowledge) weakens the individual by inhibiting the creation of the new and that adaptation thus requires knowing "how to forget at the right time". The current findings suggest that mindfulness may represent one such means through which we may overcome the inertia of our past.

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