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State Mindfulness During Meditation Predicts Enhanced Cognitive Reappraisal

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Abstract

Putatively, mindfulness meditation involves generation of a state of “nonappraisal”, yet, little is known about how mindfulness may influence appraisal processes. We investigated whether the state and practice of mindfulness could enhance cognitive reappraisal. Participants ($N = 44$; M age = 24.44, $SD = 4.00$, range 19 – 38, 82.2% female) were randomized to either 1) mindfulness, 2) suppression, or 3) mind-wandering induction training conditions. Cognitive reappraisal was assessed with the Emotion Regulation Questionnaire (ERQ) prior to experimental induction, and state mindfulness was assessed immediately following induction using the Toronto Mindfulness Scale (TMS). Participants practiced their assigned strategy for one week and then were reassessed with the ERQ reappraisal subscale. Participants receiving mindfulness training reported significantly higher levels of state mindfulness than participants in the thought suppression and mind wandering conditions. Although brief mindfulness training did not lead to significantly greater increases in reappraisal than the other two conditions, state mindfulness during mindfulness meditation was prospectively associated with increases in reappraisal. Path analysis revealed that the indirect effect between mindfulness training and reappraisal was significant through state mindfulness. Degree of state mindfulness achieved during the act of mindfulness meditation significantly predicted increases in reappraisal over time, suggesting that mindfulness may promote emotion regulation by enhancing cognitive reappraisal.

Keywords

mindfulness; cognitive reappraisal; suppression; mind wandering; emotion regulation

INTRODUCTION

The non-discursive, non-evaluative nature of mindfulness meditation is fundamental to many East Asian contemplative traditions (e.g., Zen) and is held as central to current psychological conceptualizations of mindfulness as a state, disposition, and practice (Davidson, 2010; Vago & Silbersweig, 2012). The practice of mindfulness meditation involves generation of a transient state of “nonappraisal” (Hölzel et al., 2011) in which mental experiences and sensory information are metacognitively monitored without evaluation or interpretation - putatively, cultivation of this state has pro-regulatory effects on emotion (Chambers, Gullone, & Allen, 2009). In contrast, the Western mind is more often engrossed with appraising and evaluating the meaning of events to regulate emotional responses and negotiate challenges in socio-cultural environment (Boden & Berenbaum, 2010). Though mindfulness practices cultivate non-discursive, non-evaluative states of mind, when formal mindfulness practice sessions end Westerners typically return to a narrative mode in which experience is again appraised and evaluated (Gallagher, 2000). Yet, little is known about how the state, disposition, and practice of mindfulness and mindful “nonappraisal” can fruitfully interact with a Western tradition of narrative-building and cognitive appraisal.

At first glance, the absence of conceptual and evaluative processing in mindful nonappraisal may seem akin to thought suppression or attentional distraction, two traditional forms of emotion regulation (Gross, 2002). However, mindfulness practitioners are explicitly instructed against resisting or avoiding experience, belying such hypothesized regulatory mechanisms (Hayes & Feldman, 2004). Instead, Garland and colleagues (Garland, 2007, 2013; Garland et al., 2010; Garland, Gaylord, & Fredrickson, 2011; Garland, Gaylord, & Park, 2009) theorize that cultivation of the non-evaluative state of mindfulness may enhance cognitive flexibility and therefore promote cognitive reappraisal as a means of emotion regulation. Cognitive reappraisal involves reinterpretation of the meaning of events to modulate one’s emotional responses to them (Gross, 2002). While stressful or adverse life events are often initially appraised negatively, they may be reappraised neutrally as innocuous, or reappraised positively as meaningful or even growth promoting (Lazarus & Folkman, 1984). Positive forms of reappraisal are associated with a number of salutary mental health outcomes (Helgeson, Reynolds, & Tomich, 2006).

As originally described in the Mindful Coping Model (Garland, Gaylord, & Park, 2009), mindfulness and positive reappraisal are proposed to be discrete yet complementary components of an emotion regulatory process. This “mindful reappraisal” process (Garland, 2013) is theorized to involve a number of successive stages. Initially, the practice of mindfulness meditation facilitates decentering from stress appraisals into the non-evaluative state of mindfulness, interrupting automatic emotional reactions and broadening the scope of attention to encompass previously unattended contextual information. Subsequently, by disrupting habitual responses and promoting access to a broader set of information from which novel situational appraisals can be generated, mindfulness enhances cognitive flexibility, thereby allowing for selection of adaptive reappraisals and encouraging productive reengagement with stressful life events. Recurrent engagement of the mindful reappraisal process is theorized to enhance dispositional mindfulness and the dispositional

propensity to make positive reappraisals by virtue of potential effects on neuroplasticity in brain regions associated with top-down emotion regulation and positive affectivity – a self-reinforcing feedback loop described as having an “upward spiral” dynamic (Garland et al., 2010). Though perhaps not the ultimate purpose of mindfulness training as articulated by the contemplative traditions (Bodhi, 2011; Mipham, 2000), enhanced capacity for cognitive reappraisal may be seen as an adaptive byproduct of mindfulness practice, and particularly so among Western practitioners who may be culturally wedded to narrative-evaluative processing. Indeed, contemplative scholars have recently clarified that mindfulness practices were never intended to operate in a nonjudgmental vacuum; rather, mindfulness meditation was traditionally used as a transformational practice for replacing maladaptive cognitive habits with healthy and adaptive ones (Dreyfus, 2011).

This theoretical model of mindful reappraisal has been supported by a growing number of empirical studies. In a cross-sectional survey of 118 meditation practitioners from a variety of contemplative traditions, the majority reported use of mindfulness to enhance positive reappraisal; such mindful reappraisal use was significantly positively correlated with years of meditation practice, meditation practice days per month, and meditation hours per week (Hanley, Garland, & Black, 2013). A prospective observational investigation of more than 300 participants of a mindfulness-based stress and pain management program revealed that the stress-reductive effects of enhanced dispositional mindfulness were statistically mediated by increases in positive reappraisal (Garland et al., 2011). A quasi-experimental study found that relative to college students in a standard communications class, students in a mindful communication course had significantly greater increases in dispositional mindfulness which were coupled with enhanced positive reappraisal (Huston, Garland, & Farb, 2011). Cross-sectional research indicates that reappraisal mediates the association between dispositional mindfulness and depressive symptoms among treatment-seeking patients with psychiatric disorders (Desrosiers, Vine, Klemanski, & Nolen-Hoeksema, 2013), and mediates the association between mindfulness and craving among persons with substance dependence (Garland, Roberts-Lewis, Kelley, Tronnier, & Hanley, in press). In laboratory research employing an experimental sadness induction, persons who had completed Mindfulness-Based Cognitive Therapy demonstrated significantly greater reappraisal efficacy than persons who had been treated with cognitive-behavioral therapy or a matched, untreated control group (Troy, Shallcross, Davis, & Mauss, 2012). Other lab-based studies employing electroencephalography (EEG; Gootjes, Franken, & Van Strien, 2011) and functional magnetic resonance imaging (Modinos, Ormel, & Aleman, 2010; Zeidan, Martucci, Kraft, McHaffie, & Coghill, 2013) paradigms indicate that mindfulness is linked with reappraisal through heightened activation of prefrontal cortical mechanisms. Specifically, Zeidan and colleagues (2013) found that anxiety relief during brief mindfulness meditation was associated with enhanced activation of a network of brain regions including ventromedial prefrontal cortex that are thought to instantiate cognitive reappraisal processes. Thus, mounting evidence suggests that reappraisal capacity may be enhanced by cultivating the disposition and perhaps the state of mindfulness through practice of mindfulness meditation.

The aim of the present study was to experimentally test whether mindfulness training promotes cognitive reappraisal and whether the induction of state mindfulness during the act of mindfulness meditation is associated with enhanced cognitive reappraisal. We had two

primary hypotheses. First, we hypothesized that brief mindfulness training would lead to greater increases in reappraisal than the practice of suppression - an active, response-focused emotion regulation strategy (Gross, 2002), or mind wandering - a passive, unregulated mental state; these two psychological processes are held to be antithetical to mindfulness and often used as control conditions in experimental mindfulness research (Cahn & Polich, 2009; Farb, Segal, & Anderson, 2013; Hooper, Davies, Davies, & McHugh, 2011; Mrazek, Smallwood, & Schooler, 2012). Second, because state mindfulness is presumed to facilitate cognitive flexibility and transform maladaptive cognitive habits, we hypothesized that the state of mindfulness achieved during active mindfulness meditation would be positively and prospectively associated with increases in reappraisal, and would mediate the effect of mindfulness training on reappraisal. To further explicate any observed changes in reappraisal associated with the experimental inductions, we conducted supplementary, exploratory analyses to examine the association between dispositional mindfulness and habitual use of reappraisal.

METHOD

Participants and Procedure

Participants were recruited from Florida State University to participate in a research study focused on “learning ways to manage stressful thoughts and emotions.” A total of 44 individuals (M age = 24.44, SD = 4.00, range 19 – 38, 82.2% female) consented to participate in the study and attended the Time 1 experimental session. Consenting participants, who were blinded to experimental condition, were randomly assigned to receive either a brief mindfulness training induction (n = 15), a suppression induction (n = 15), or a mind wandering induction (n = 14). First, participants completed the reappraisal subscale of the Emotion Regulation Questionnaire (Gross & John, 2003) and the Five Facet Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, Toney, 2006). Next, they listened to one of three, 13 minute long, audio-recorded inductions and then immediately completed the Toronto Mindfulness Scale (Lau et al., 2006) to describe their experiences during the induction. Afterward, participants were given a digital audio copy of the induction and asked to follow the instructions on the audio-recording at least two times over the following week. Experimental induction groups did not significantly differ with regard to the number of times they listened to the recording, p = .35 (mindfulness M = 2.2, SD = 1.1; suppression M = 1.9, SD = .3, mind wandering M = 1.8, SD = .7) Seven days later, participants returned to the lab for the Time 2 session, and once again completed the reappraisal subscale of the Emotion Regulation Questionnaire and the Five Facet Mindfulness Questionnaire. Individuals were debriefed and received course credit for participating in the research project. This protocol was approved by the Florida State University IRB.

Inductions

Mindfulness: The 13 minute long, mindfulness meditation script accorded with typical, basic mindfulness instructions delivered in modern mindfulness-based interventions (e.g., Garland, 2013; Kabat-Zinn, 1990; Segal, Williams, & Teasdale, 2002):

“When you’re ready, you can get your body into a comfortable yet alert posture... You can begin to come aware of the state of the body in this moment... Is the body tired or full of energy, right now?... Is it relaxed or tense?... It really doesn’t matter, just noticing the state of the body in this moment... And in a moment noticing the state of the mind... Is it full of thoughts, or mostly empty of thoughts? ... Are the thoughts moving fast or are they moving slowly?... And again, it really doesn’t matter... Whatever the state of the mind is in this moment, it’s okay, just noticing the state of the mind in this moment... And when you’re ready, you can shift the focus of your attention to the sensation of the breathing... Noticing the sensation of the breath as it flows in to the nostrils when you inhale... Noticing the warmth or the coolness of that air as you breathe... Noticing perhaps the movements of the tiny muscles in the nostrils as you inhale... And soon following the breath even more deeply into the body... Noticing the sensation of the breath filling the lungs, filling the belly with each passing breath... And soon you may begin to notice that the mind begins to wander, to thoughts, feelings, sensations in the body, images, or memories... And when you notice that the mind has wandered, that’s okay, because that’s what minds do, they wander... You can just notice where the mind has wandered off to, accepting and acknowledging those thoughts and feelings... Soon you may begin to notice that your thoughts and feelings, images and memories, come and go... Come and go, like clouds passing in a clear blue sky... Like clouds, your thoughts come out of nowhere, change shape and fade into the distance all on their own... And there is no need to hold on to those thoughts or to push them away... You can just let them go, all on their own... And a part of the mind is like those thoughts or feelings, like clouds passing... But there is a deeper part of the mind that is more like the space in which the clouds pass... An observing awareness... And you can focus your mind on that, or you can continue to focus your mind on the sensation of the breath flowing into the nostrils...

Suppression: Following Hooper et al. (2011), participants were instructed to not think about what was bothering them. This set of instructions was repeated for 13 minutes to match the length of the mindfulness induction

“When you’re ready, you can take a moment and then try not to think about anything that is bothering you, stressing you, or upsetting you in your life... When an unwanted thought comes to mind, simply try to remove it... Concentrate on getting rid of unwanted thoughts... Don’t think about what is bothering you, stressing you, or upsetting you in your life... But each time an unwanted thought enters your mind continue to remove it... When the unwanted thought enters your mind, try to put it away from your conscious awareness... You can think about whatever comes to mind except thoughts about what is bothering you, stressing you, or upsetting you in your life... Watch out for upsetting thoughts, removing them each time they appear...”

Mind wandering: Following Cahn and Polich (2009), participants were told to let their mind wander freely through neutral thoughts. This control condition was chosen so as to

emulate a mind wandering state with high ecologic validity. This set of instructions was repeated for 13 minutes to match the length of the mindfulness induction:

“When you’re ready, you can start by allowing your mind to roam; there is no need to focus on anything in particular... Just let your mind wander... Openly let your thoughts flow... Let yourself think freely about whatever you want, just let your mind wander... Think about whatever comes to mind... Allow your mind to roam; there is no need to focus on anything in particular... Just let your mind wander... Openly let your thoughts flow... Continue to let yourself think freely about whatever you want, just let your mind wander...”

It is important to note that the word “mindfulness” was not used in any of the inductions, nor was it used in any of the recruitment materials or scripts. Similarly, none of the inductions mentioned reappraisal or any concept synonymous with or directly related to reappraisal.

Measures

State mindfulness: State mindfulness was measured with the 13-item Toronto Mindfulness Scale (Lau et al., 2006), which asks respondents to rate how well a series of statements describes what they personally experienced during a particular session of mindfulness meditation, including items tapping *decentering* such as “I experienced myself as separate from my changing thoughts and feelings” and items tapping *curiosity* such as “I was more concerned with being open to my experiences than controlling or changing them.” Responses are scored on a Likert scale ranging from 0 = not at all to 4 = very much and summed to compute a total score ($\alpha = .90$), as well as decentering and curiosity subscale scores.

Dispositional mindfulness: The Five Facet Mindfulness Questionnaire, comprised of 39 Likert-type items rated on a five-point scale (1 = never or very rarely true, 5 = very often or always true), was used to measure dispositional mindfulness (Baer et al, 2006). The FFMQ yields a total score (computed by summing responses across all 39 items, $\alpha = .78$) and scores for five internally consistent mindfulness factors each with their own convergent and predictive validity: nonreactivity to inner experience (tapped by items such as “I watch my feelings without getting lost in them”), observing and attending to experience (“I pay attention to sensations, such as the wind in my hair or the sun on my face”), describing and discriminating emotional experiences (“I’m good at finding words to describe my feelings”), nonjudging of experience (reverse coded item: “I tell myself I shouldn’t be feeling the way that I am feeling”), and acting with awareness (reverse coded item: “I find myself doing things without paying attention”).

Cognitive reappraisal: Cognitive reappraisal was measured with the six-item, reappraisal subscale of the Emotion Regulation Questionnaire (Gross & John, 2003), comprised of items such as, “When I want to feel more *positive* emotion (such as joy or amusement), I *change what I’m thinking about*,” “When I want to feel less *negative* emotion (such as sadness or anger), I *change what I’m thinking about*,” and “When I’m faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.” Responses are

scored on a Likert scale ranging from 1 = strongly disagree to 7 = strongly agree and summed to compute a total score ($\alpha = .86$).

Statistical Analysis—A priori, we hypothesized that brief mindfulness training would result in significantly greater increases in cognitive reappraisal than the thought suppression and mind wandering conditions. Thus, we conducted a repeated-measures Analysis of Variance (RM-ANOVA) to examine changes in cognitive reappraisal between Time 1 and Time 2 as a function of induction condition. In light of prior research demonstrating age (Opitz, Rauch, Terry, & Urry, 2012) and gender differences in cognitive reappraisal (McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008), we conducted a supplementary analysis examining change in reappraisal with repeated-measures Analysis of Covariance (RM-ANCOVA), after statistically controlling for age, gender, and practice effects (i.e., the number of times participants listened to the induction recording in the week between Time 1 and Time 2).

In addition, we measured the effects of induction on state mindfulness at Time 1. It was theorized that response to induction at Time 1 would provide an indication of ability to enter into mindful states and therefore benefit from regulation practice. For this analysis, we conducted an Analysis of Variance (ANOVA) of state mindfulness scores with planned comparisons using linear contrasts of weighted group means to compare participants assigned to the mindfulness condition to individuals assigned to the other two conditions.

To evaluate the association between state mindfulness achieved during mindfulness meditation and residualized change in cognitive reappraisal, we first ran a linear regression model of data from mindfulness training participants ($n = 15$) with Time 1 state mindfulness as the predictor variable, Time 1 reappraisal as a covariate, and Time 2 reappraisal as the dependent variable. This analysis was then repeated for the decentering and curiosity subscale scores separately. Next, we conducted a path analysis of the whole sample ($N = 44$) to determine whether state mindfulness mediated the effect of mindfulness training on increases in reappraisal. In this path model, experimental condition (mindfulness versus the other two conditions) was entered as the independent variable, state mindfulness was entered as the mediator variable, Time 1 reappraisal was entered as a covariate, and Time 2 reappraisal was entered as the dependent variable. We used a bias corrected bootstrap test with 1000 bootstrap samples to determine the significance of indirect effects (Preacher & Hayes, 2008).

Lastly, we conducted several supplementary, exploratory analyses. We examined zero-order correlations between state mindfulness, dispositional mindfulness, and habitual use of reappraisal, and conducted a RM-ANOVA to examine changes in dispositional mindfulness and mindfulness facets between Time 1 and Time 2 as a function of induction condition.

RESULTS

Manipulation check: effects of induction on state mindfulness

Significant effects of induction on state mindfulness were observed at Time 1, $F(1,42) = 4.27$, $p = .045$. Participants receiving the mindfulness induction reported significantly higher

levels of state mindfulness ($M = 46.40$, $SD = 11.00$) than participants in the suppression ($M = 40.53$, $SD = 9.62$) and mind wandering conditions ($M = 38.27$, $SD = 11.61$), indicating that the mindfulness training induction was successful in inducing the state of mindfulness.

Effects of induction on cognitive reappraisal

Repeated measures ANOVA revealed a significant time effect on cognitive reappraisal, $F(1,41) = 4.65$, $p = .037$, $\eta^2 = .10$, indicating that across all three groups, reappraisal significantly increased from Time 1 to Time 2. However, there was no significant time X condition effect, $F(2,41) = .49$, $p = .62$, $\eta^2 = .02$, suggesting that the observed change in cognitive reappraisal did not significantly differ between the experimental induction groups. In a sensitivity analysis, we statistically controlled for practice effects, as well as participant age and gender, in a repeated measures ANCOVA. Again, no significant time X condition effect was observed.

Prospective association between state mindfulness and cognitive reappraisal

Linear regression analysis of data from participants assigned to the mindfulness training condition ($n = 15$) indicated that the state of mindfulness achieved during mindfulness meditation was prospectively, positively associated with increases in cognitive reappraisal. State mindfulness was a statistically significant and robust predictor of increases in reappraisal, accounting for an additional 20% of the variance in residualized change in reappraisal scores. The overall model R-squared was .62 (see Table 1). Thus, individuals who experienced the highest levels of state mindfulness during the lab-based mindfulness induction reported the largest increases in cognitive reappraisal from Time 1 to Time 2 (see Figure 1). Analyzing subscales from the Toronto Mindfulness Scale separately, curiosity scores were significantly prospectively associated with increases in reappraisal ($p = .028$), whereas decentering scores were only marginally associated with increases in reappraisal ($p = .067$). In contrast, no significant associations between state mindfulness and residualized change in reappraisal were observed for the suppression and mind wandering groups.

Path model

Path analysis of the entire sample ($N = 44$) revealed that individuals in the mindfulness training condition had higher levels of state mindfulness than those in the other two conditions, and that higher state mindfulness during induction was in turn associated with greater increases in cognitive reappraisal over the following week (see Figure 2). We employed a bias corrected bootstrap test to determine the significance of indirect effects. The bias corrected bootstrap 95% CI indicated that the indirect effect of group assignment (mindfulness training versus the other two experimental conditions) through state mindfulness on cognitive reappraisal was significant, $a \times b = 1.67$, bootstrap SE = .89, 95% CI: (.31, 4.11).

Additional associations between state mindfulness, trait mindfulness, and reappraisal

Across the entire sample, dispositional mindfulness at Time 1 was positively associated with state mindfulness during the induction ($r = .43$, $p = .003$) and greater increases in reappraisal from Time 1 to Time 2 ($r = .41$, $p = .005$). Though there were no significant between-groups

differences in changes in trait mindfulness or most of the trait mindfulness subscales from Time 1 to Time 2, there was a significant group \times time interaction on the nonreactivity subscale of the FFMQ, $F(1,41) = 3.92, p = .028, \eta^2 = .16$. Individuals receiving brief mindfulness training evidenced significant increases in nonreactivity from Time 1 to Time 2, $t(14) = 2.18, p = .047$, whereas there was no significant change in nonreactivity for the suppression or mind wandering conditions. Importantly, increases in nonreactivity were correlated with increases in cognitive reappraisal over the week ($r = .43, p = .003$).

DISCUSSION

The present study sought to examine effects of the practice and state of mindfulness on cognitive reappraisal, and in so doing, provide a test of the Mindful Coping Model (Garland et al., 2009). Our hypotheses were partially supported by the data. Although brief mindfulness training did not lead to significantly greater increases in cognitive reappraisal than a suppression or mind wandering condition, the degree of state mindfulness achieved during the act of mindfulness meditation was a significant predictor of increases in cognitive reappraisal over time. While formal mediation could not be definitively established due to the absence of a direct effect of brief mindfulness training on cognitive reappraisal (Baron & Kenny, 1986), the indirect effect group assignment (brief mindfulness training versus the other two conditions) on cognitive reappraisal was significant through state mindfulness. In addition, brief mindfulness training was associated with significant increases in dispositional nonreactivity, which were in turn associated with increased reappraisal use over time. Overall, study findings suggest that the state of mindfulness induced by mindfulness meditation is linked with cognitive reappraisal as a means of emotion regulation.

The lack of between-groups differences in changes in reappraisal raises the possibility that mindfulness training may not cause increases in reappraisal. Alternatively, the fact that the mindfulness training condition did not result in greater enhancements in reappraisal than the control conditions might be due to the brevity of training: on average, participants engaged in 40 minutes of mindfulness practice over one week, which may have been insufficient to produce pronounced effects on reappraisal. Instead, only participants who experienced comparatively greater states of mindfulness during meditation were likely to differentially benefit from the mindfulness induction. It is possible that larger doses of mindfulness training might result in more profound enhancement of reappraisal, potentially through an improved capacity to generate and sustain mindful states. In support of this hypothesis, participation in an eight-week mindfulness-based stress and pain management program was associated with significant increases in positive reappraisal (Garland et al., 2011), and years of meditation practice experience has been positively associated with mindful reappraisal use in a survey of contemplative practitioners (Hanley et al., 2013).

Accordingly, some contemplative traditions describe the establishment of “wise mindfulness,” a more advanced practice predicated on a foundation of mindful attention, which is seen to promote *samprajñā* or clear comprehension of experiences as a means of seeing them in a different light (Dreyfus, 2011). In that regard, within the Tibetan Buddhist *lojong* tradition, mindfulness training is thought to foster the advanced contemplative teaching of *dukngal lam du drub pa*, translated as “transforming adversity into the path of

awakening,” a method of reappraising adverse life events into opportunities for spiritual practice (Kyabgon & Wilber, 2007; Wallace, 2003). This path to insight may be opaque to novice practitioners engaged in the basic practice of mindfulness as cultivating nonjudgmental, present-centered awareness (Dreyfus, 2011). Consistent with this notion that long-term practice of cultivating state mindfulness may be needed in order to accrue into trait-level or dispositional changes in cognitive and emotional function, recent neuroimaging research demonstrates that the magnitude of structural differences (Froeliger, Garland, & McClernon, 2012), functional emotion-cognition interactions (Froeliger, Garland, Modlin, & McClernon, 2012), and resting-state functional connectivity (Froeliger et al., 2012) is a function of mindfulness practice experience.

Nonetheless, the state of mindfulness induced via a single session of mindfulness meditation was prospectively and robustly associated with increases in cognitive reappraisal, suggesting that the ability to decenter from and openly observe mental experiences may foster reinterpretation of such experiences as a means of transforming one’s emotional response to them. While both of these abilities may be important to the mindful reappraisal process, data from the present sample indicate that the curiosity dimension of state mindfulness was more strongly associated with reappraisal than decentering. Concomitantly, brief mindfulness training enhanced dispositional nonreactivity, that is, the propensity to metacognitively disengage from distressing mental experiences, which was in turn associated with increased reappraisal use over time. Taken together, these findings suggest the following speculative explanation: open monitoring of habitual appraisals with an attitude of curiosity during the act of mindfulness meditation, coupled with nonreactive disengagement from mental experience, might have fostered deautomatization of habitual cognitive sets and scripts and thereby augmented the dispositional propensity to use reappraisal as an emotion regulatory strategy in the week following meditation. Yet, without follow-up data, it is unknown how stable this effect is over time. More research is needed to test this hypothesis and examine the dose/response relationship between state mindfulness, dispositional mindfulness, and reappraisal habits. In addition, equivocal support for our causal hypothesis necessitates future studies to examine the complexity of the Mindful Coping Model and refine the theory as needed. For instance, because this model proposes broadened attention as a mediator of the mindfulness-reappraisal linkage, attentional measures should be employed to provide a more complete test of the theory.

The presence of a significant indirect effect in our path model indicates that the gains in reappraisal evidenced by mindfulness training participants may be partially accounted for by the degree of state mindfulness they achieved during the act of meditation. Though level of state mindfulness during mindfulness meditation explained one fifth of the variance in change in reappraisal, clearly other cognitive and affective processes contribute to this emotion regulatory strategy. It may be that there are many pathways to promoting reappraisal, state mindfulness being only one. For instance, the perspective taking and logical disputation of thought so crucial to cognitive-behavioral therapy may also facilitate reappraisal - these processes, like mindfulness, may recruit top-down, cortico-limbic modulation of bottom-up emotional impulses (Clark & Beck, 2010). In that regard, a recent study found that meditation-related anxiety reduction was associated with increased

activation in a network of brain regions involved in cognitive reappraisal, including the ventromedial prefrontal cortex (Zeidan et al., 2013).

Across all three study conditions, participants reported significant increases in cognitive reappraisal over a one week period. This finding in itself is important, in that cognitive reappraisal use is often considered a habitual emotion regulatory strategy in the literature (Gross & John, 2003). Possibly, exposure to and practice with novel regulatory techniques through any of the inductions over the course of the week may have fostered reappraisal. Alternatively, it may be that the observed increases in cognitive reappraisal were the result of demand characteristics, as the stated purpose of the study was to learn ways of coping with stress. More intriguingly, it may be the case that aspects of all three techniques contribute to reappraisal in complimentary but independent ways: for example, mindfulness may allow for disruption and subsequent transformation of habitual appraisals, and mind-wandering may be used to generate creative, novel, and alternative explanations for events, i.e., content for reappraisals. Without tracking the use of each of these techniques, we cannot be sure of their interaction, but flexible use of multiple regulatory techniques may promote reappraisal. This hypothesis could be tested with studies employing multimodal interventions and dismantling designs.

The present study was limited by a small sample size ($n = 15$ for regression analysis and $N = 44$ for path analysis) which may have limited statistical power to detect significant between-groups differences. Furthermore, reliance on self-report measures may have compromised our ability to discern between-groups effects on reappraisal over time, due to the possibility of testing and instrumentation effects which may have exposed study hypotheses and biased responses. In addition, the instructions used in the inductions might have differed in important ways from those used in other mindfulness induction studies, thus accounting for the observed effects. Lastly, findings were based on a university sample whose data may be neither widely generalizable nor generalizable to clinical populations. Future studies should seek to test and replicate our findings with larger, community samples, employing neuroimaging paradigms, psychophysiological measures, and performance-based behavioral tasks to ascertain the effects of the state and practice of mindfulness on cognitive reappraisal. For instance, the standardized emotion regulation paradigm used by Ochsner, Gross, and colleagues (2004; 2002) could be coupled with functional magnetic resonance imaging to assess the mindfulness-reappraisal linkage: following a brief mindfulness induction as compared to a control condition, participants could be asked to reappraise aversive images in the scanner. This paradigm could distinguish the neural correlates of mindful reappraisal from those of reappraisal in the absence of state mindfulness. Future studies should also measure changes in the ability to engage in the mindful state to determine whether mindfulness training increases capacity for cognitive reappraisal by improving access to mindful states, an important implication of the current findings. Accordingly, researchers should vary the dose of mindfulness practice to determine the amount of training required to optimally facilitate reappraisal, and compare long-term adepts to novice mindfulness practitioners to explore meditation experience as a moderator the relation between mindfulness and reappraisal. Increasingly refined mindfulness-based training approaches and measures may be needed to disentangle *samprajñāna*, the clear

comprehension aspect of mindfulness, from *sati*, the attentional property of mindfulness that allows one to retain the mental object of contemplation. It may be that certain contemplative practices foster reappraisal more than others, and that different mindfulness-based interventions may use these practices to varying degrees to accentuate or de-emphasize mindful reappraisal.

In sum, the present study provides an early experimental test of the Mindful Coping Model. Study findings provide additional support for the notion that cultivation of the mindful state may augment cognitive reappraisal by allowing for flexible selection of adaptive interpretations of experience. How these salutary mental functions are linked still remains a question to be explored in future mechanistic and neurophenomenological research.

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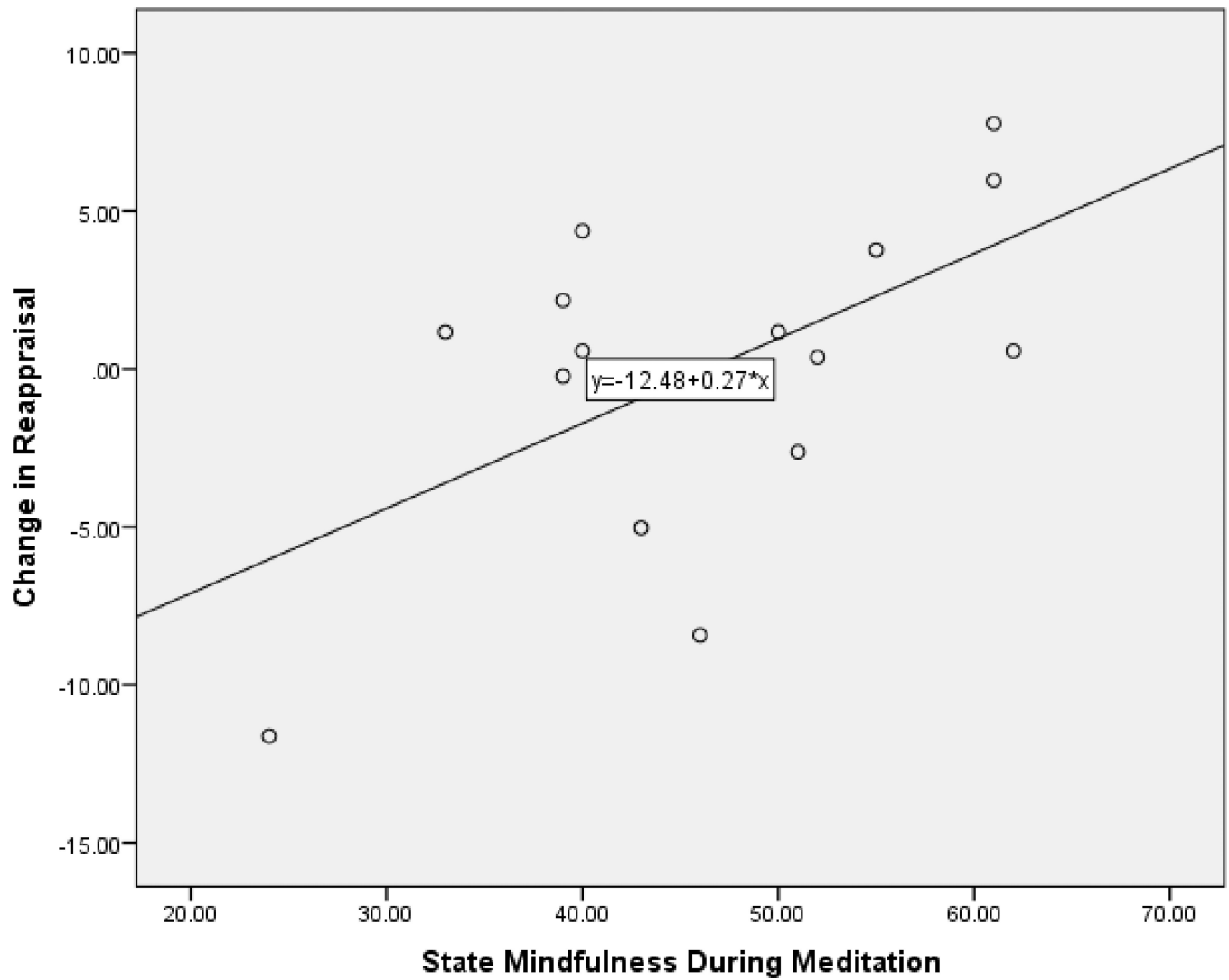


Figure 1.

Scatterplot depicting the association between state mindfulness achieved during the act of mindfulness meditation and residualized changes in reappraisal in the following week. Data points represent individual cases within the brief mindfulness training condition. Higher values on the Y-axis denote increased use of cognitive reappraisal from Time 1 to Time 2.

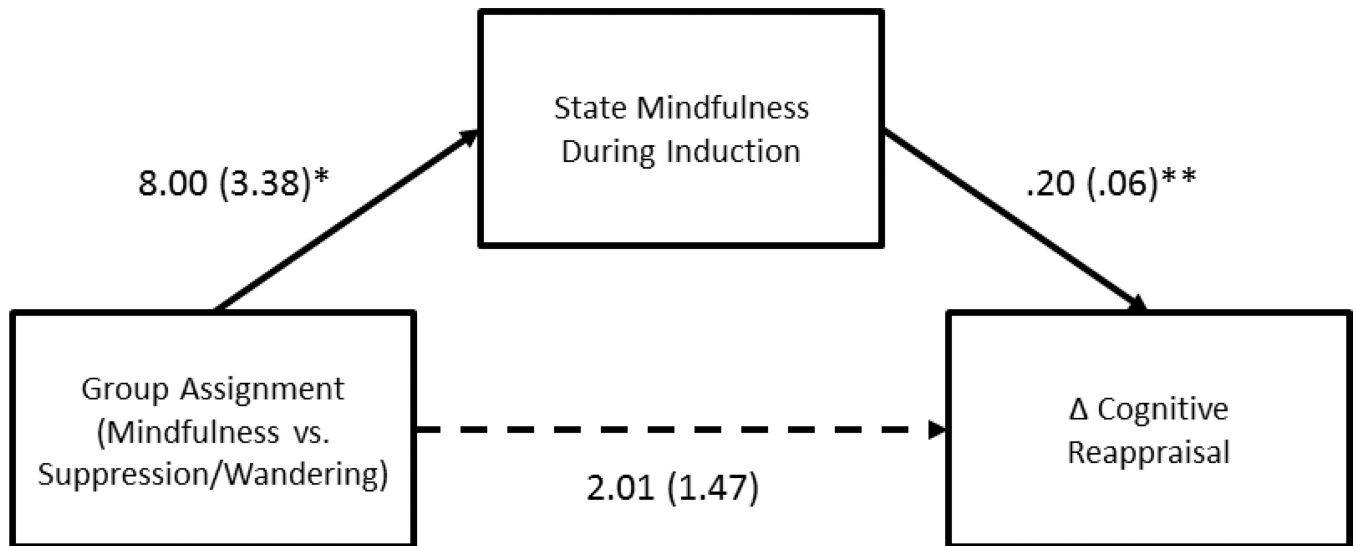


Figure 2.

Path model of state mindfulness as a mediator of the effects of mindfulness training on residualized change in cognitive reappraisal ($N = 44$). Unstandardized coefficients are presented. Though the direct effect between group assignment (mindfulness training versus suppression/mind wandering) and reappraisal was not significant, a bias-corrected bootstrap test indicated the significance of the indirect effect of group assignment (mindfulness training versus suppression/mind wandering) on reappraisal through state mindfulness: $a \times b = 1.67$, bootstrap SE = .89, 95% CI: (.31, 4.11). Model R-squared = .54.

Regression model testing the prospective association between state mindfulness and cognitive reappraisal within participants randomly assigned to brief mindfulness training (N = 15).

Table 1

	B	SE	Beta	t	p	Sig F change
Step 1 ^a						.009
Constant	13.230	5.442		2.431	.030	
Time 1 reappraisal	.600	.197	.646	3.048	.009	
Step 2 ^b						.028
Constant	2.556	6.287		.407	.691	
Time 1 reappraisal	.511	.170	.550	3.002	.011	
State mindfulness	.281	.113	.456	2.490	.028	

^aModel R-squared = .42

^bModel R-squared = .62