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Does mindfulness reduce negativity bias? A potential mechanism for reduced emotional distress

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DOES MINDFULNESS REDUCE NEGATIVITY BIAS? A POTENTIAL MECHANISM FOR REDUCED EMOTIONAL DISTRESS.

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

by

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Abstract

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The present research examined if mindfulness reduced negativity bias on measures of attitude formation and cognitive style, as a potential explanation for the beneficial effects of mindfulness on emotional disturbance. Two studies were conducted. Study One was correlational and found that trait mindfulness inversely correlated with measures of negative cognitive style, and that the latter partially mediated an inverse association between mindfulness and predisposition to depression and anxiety. Further, correlations between mindfulness and both positive attitude formation and optimism hinted at a potential positivity bias. Study Two extended these findings using a randomized experimental design comparing a mindfulness induction to an unfocused

attention control condition. The mindfulness condition demonstrated a positivity bias in attitude formation and increased optimism compared to the control condition, but did not demonstrate bias in attitude generalization. Potential explanations and implications for emotional disturbance are discussed.

CHAPTER 1 Introduction

Mindfulness has been described as a certain attentional quality brought to moment-by-moment experience (Kabat-Zinn, 1990). Cultivating this particular quality of consciousness is thought to confer mental health benefits (Lutz, Dunne, & Davidson, 2007). Indeed, a substantial body of literature supports the usefulness of mindfulness-based approaches for preventing or reducing emotional disturbance (cf. Brown, Ryan, & Creswell, 2007). However, little research has focused on the mechanisms by which mindfulness may do so. One possibility is that mindfulness may reduce the influence of biases in cognitive processing. Theories of mental health generally maintain that a relatively accurate view of reality facilitates psychological adjustment (Leary, 2004), and many researchers include the terms "unbiased" and "objective" in descriptions of mindful awareness (Brown et al., 2007; Shapiro, Carlson, Astin, & Freedman, 2006). For example, mindfulness "is thought to allow the person to 'acknowledge and accept the situation for what it is' … In terms of implicated psychological processes, this seems to involve reliance less on preconceived ideas, beliefs, and biases and more on paying attention to all available information" (Bishop, 2002, p. 74). However, there is a lack of empirical data demonstrating a causal link between mindfulness and reduced bias. The present research will test this proposed mechanism for benefits of mindfulness, specifically investigating negativity bias.

Mindfulness: An Overview

The concept of mindfulness has roots in Eastern, particularly Buddhist, meditation practices yet is described as a universally inherent capacity that enhances insight into the nature of experience and mitigates psychological suffering (Kabat-Zinn, 2003). It has been conceptualized as a nonjudgmental awareness of and attention to current internal and external experiences (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008).

Dismantling this definition, the foundation of mindfulness is sustained attention (Brown et al., 2007). Moreover, it involves awareness of the direction of attention and potentially the ability to flexibly switch attention between thoughts or feelings and present stimuli (Bishop et al., 2004). Bishop and colleagues explain that this metacognitive process of attention regulation maintains a nonelaborative stance toward thoughts, feelings and sensations as they occur. If a thought or feeling elaborates past initial perception of a stimulus, cognitive inhibition can reduce further elaboration. This inhibition should not be confused with suppression because thoughts and feelings are acknowledged as they arise. They are simply noticed rather than entertained automatically. This reduction of mental elaboration facilitates an orientation toward current experience. Less attention on elaborative thinking should free conscious resources to process information that is immediate to the present moment (Martin, 1997). In this way, mindfulness is considered to entail a wider perspective that detects and integrates information with greater attention, moment by moment.

Willing, receptive observation of information involves an additional feature of mindfulness: a nondiscriminatory interest in experience, often called acceptance (cf.

Bishop et al., 2004; Cardaciotto et al., 2008). Not to be confused with passivity or resignation, acceptance here reflects an active process of being open to and curious about all information rather than letting awareness adhere to some limited or judgmental agenda. All current information and experience is potentially subject to observation. Some stress that within the traditional notion of mindfulness, this acceptance entails kindness and compassion (e.g., Grossman, 2008; Kabat-Zinn, 2003). Still, it may be best to view such qualities as distinct correlates of mindfulness to avoid confounding the construct (Bishop et al., 2004).

Mindfulness can be examined as a trait as it is considered an inherent capacity and individuals may vary in their general level of mindfulness in everyday functioning (e.g., Brown & Ryan, 2003). For example, when eating mindfully, one attends to the various immediate sensations of the food as if it is novel. Consider an apple. When mindful, one might first notice its color, shape, size, and texture. Upon biting into it, the apple might be characterized as crisp or mealy, sweet or bland, and juicy or rather dry. One might also notice how it feels against the lips, teeth and tongue. When reactions, such as feelings of pleasure or distaste and thoughts like "this is good (or bad)" occur, they are observed and noticed as momentary internal phenomena. This process can be contrasted with mindlessly consuming the apple: being completely preoccupied in other thoughts without noticing and implicitly assuming that one already knows what an apple is like. Such a continuum of mindfulness to mindlessness is possible in various everyday activities and events. Measurements of trait mindfulness attempt to assess where on this continuum individuals tend to be throughout daily life.

Mindfulness also may be investigated as a state or mode into or out of which one enters (e.g., Bishop et al., 2004) or that can be heightened. From this perspective, mindfulness is akin to an attentional skill that one can practice and learn to employ, and that is relatively absent when not employed. Mindfulness meditation is a practice used to cultivate a mindful state or mode; state measures of mindfulness can be used immediately after practice to assess the degree to which mindfulness was evoked. It is not yet clear if and to what degree such practices increase trait mindfulness (Thompson & Waltz, 2007) although some research suggests that they do (e.g., Shapiro, Oman, Thoresen, Plante, & Flinders, 2008).

The conceptualization of mindfulness just described should be distinguished from Langer's (1989) conceptualization of mindfulness as the active creation of new categorizations for or perspectives toward stimuli. Langer's conceptualization refers more to a particular cognitive activity oriented toward external stimuli, rather than a receptive observation of both internal and external occurrences. There may be some similarity in terms of being engaged with stimuli as if they were new, which is supported by moderate (.23-.39) correlations between related subscales of Langer's trait mindfulness scale (Bodner & Langer, 2001) and a measure of trait mindfulness based on the conceptualization used here (Brown & Ryan, 2003). For this reason it is noteworthy that Langer has proposed (cf. Langer, 1989) and in some cases found (e.g., Dijikic, Langer, & Stapleton, 2008) that her conceptualization of mindfulness reduces reliance on biases. However, both Langer and mindfulness meditation researchers agree that the two

conceptualizations of mindfulness differ substantially (e.g.,Bishop et al., 2004; Brown et al., 2007).

Benefits of Mindfulness

Mindfulness has received considerable attention in the clinical literature in terms of its benefits as part of interventions or particular practices; it also has received some, albeit much less, attention in other domains of psychology and as an isolated construct (cf. Baer, 2003; Bishop, 2002; Brown et al., 2007). The extant literature suggests that mindfulness is beneficial to one's well-being. Correlational studies have demonstrated that measures of trait mindfulness are associated with lower levels of psychological distress (e.g., depression, anxiety, hostility and stress) and associated with higher levels of psychological well-being (e.g., positive affect, competence, vitality and life satisfaction) (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Brown & Ryan, 2003; Cardaciotto et al., 2008).

The bulk of experimental research has examined the effects of mindfulness meditation, especially the efficacy of interventions based on such practices. Mindfulness research gained momentum roughly 25 years ago with the development and evaluation of Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 1982). MBSR is a multi-component, eight-week intervention that teaches mindfulness skills to reduce stress and improve coping with physical and psychological ailments. Participants learn and practice mindful attention toward various experiences, such as the qualities of each breath as it occurs, sensory aspects of eating a common food, and sensations of the body during yoga. Two meta-analyses (Baer, 2003; Grossman, Niemann, Schmidt, & Walach, 2004)

indicate that MBSR leads to improvements on various measures of mental and physical health, with moderate effect sizes.

Additional mindfulness-based treatments have been developed specifically to address psychological disorders (cf. Brown et al., 2007). Most relevant to the present work is Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002). Like MBSR, MBCT centers on mindfulness practices. It also includes aspects of cognitive therapy (CT; Beck, Rush, Shaw, & Emery, 1979). Growing evidence supports the efficacy of MBCT for preventing relapse of depression (Baer, 2003; Segal et al., 2002; Williams, Russell, & Russell, 2008) and its promise for anxiety disorders including generalized anxiety disorder (Evans et al., 2008; Roemer & Orsillo, 2002, 2007).

Cognitive Theories of Depression and Anxiety

Cognitive theories of depression and anxiety provide a well-established and clinically relevant framework in which to examine how mindfulness practices may benefit psychological well-being. Cognitive approaches emphasize negatively biased cognitive processes as a cause of depression and anxiety. Thus, cognitive therapy focuses on changing these cognitive biases to alleviate the emotional disorders.

In terms of depression, according to the two major cognitive theories – hopelessness theory (Abramson, Metalsky & Alloy, 1989) and Beck's (1987) theory – negatively biased cognitive styles increase vulnerability to depression. Using a prospective design, Alloy and colleagues (2000, 2006) demonstrated that negative inferential tendencies and dysfunctional attitudes (unrealistic and negatively biased assumptions about oneself, the world, and the future) predicted onset as well as higher

lifetime prevalence of major depressive disorder. Further, a recent review (Garratt, Ingram, Rand, & Sawalani, 2007) concluded that cognitive changes, such as improvements in dysfunctional attitudes and attributions, resulting from cognitive therapy predict improvements in depressive symptoms. It also is important to note that the most current evidence does not support the depressive realism hypothesis. Depressive realism contradicts the notion that depressed individuals are negatively biased by contending that depressed individuals are more realistic than nondepressed individuals. Most research on this hypothesis has yielded inconsistent findings and has been criticized for using methods with no objective or reliably agreed upon standard of reality (Ackermann & DeRubeis, 1991). Thus, to create a more valid test of the depressive realism hypothesis, Moore and Fresco (2007) evaluated participants' accuracy using (a) objectively real events and causes, and (b) pre-determined rating standards based on multiple, extensively trained raters who met a high level of inter-rater reliability, thereby limiting rater bias. Their study found that depressed individuals were less realistic, showing a significant negativity bias, compared to nondepressed individuals.

Cognitive theories of anxiety disorders also focus on negatively biased cognitive patterns. Central to such theories is an overestimation of threat based on schemas of danger that distort information processing (e.g., Beck & Clark, 1997). The looming vulnerability model (LVM; Riskind, 1997; Riskind, Williams, & Joiner, 2006) identifies a cognitive style that is common in anxiety disorders but unique from depressive cognition. Looming vulnerability refers to a dynamic sense of a risk that grows rapidly with time or proximity. This can be an appropriate response if it adjusts proportionately

to the actual level of threat, but it becomes dysfunctional the more that it does not accurately correspond to reality. The looming cognitive style may underlie many cognitive biases that have been implicated in anxiety, including disproportionate allocation of attention to threats rather than safety cues, less habituation to feared stimuli, and interpretations biased toward danger (cf. Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & Ijzendoorn, 2007). Further, inducing such biases has been found to cause anxiety (Mathews & MacLeod, 2002).

Although the precise nature of the cognitive biases in depression and anxiety can differ, it is clear that both disorders involve biases toward negativity. A complementary finding demonstrated that greater predisposition to both depression and anxiety was associated with biased learning and attitude formation (Shook, Fazio, & Vasey, 2007). Specifically, participants who scored higher on depression and anxiety scales demonstrated poorer learning of positively valenced novel stimuli, whereas there was no difference in learning of negative stimuli. Thus, individuals who were predisposed to depression and anxiety had a tendency to form more negative attitudes than positive attitudes. Thus, an under-appreciation for positive stimuli may underlie both disorders.

In its traditional form, cognitive therapy (CT) aims to weaken the negativity biases underlying depression and anxiety by changing their roots: an underlying negatively biased schema (Beck et al., 1979). This approach of schema modification has been described as an *accommodation* model of change (Hollon, Evans, & DeRubeis, 1990). It aims to directly alter cognitive content (e.g., through problem solving, testing the validity of thoughts, and substituting rational beliefs for irrational ones) so it is less

negatively biased. Because changes in a schema cannot be measured directly, reduced biases in attention, attributions, interpretations and attitudes serve as indications of schema change (Garratt et al., 2007). Thus, a goal of traditional CT often is to restructure the content of an individual's thoughts, so that their beliefs and feelings are less negatively biased. To achieve this goal, individuals may be encouraged to consider the validity and necessity of their existing perspectives while also considering alternate interpretations of experiences and events.

Similar to aspects of CT, MBCT teaches individuals to develop awareness of thoughts and feelings as impermanent mental events of questionable truth rather than as necessarily accurate accounts of self or reality. Although the approach of MBCT is related to that of CT, the focus of MBCT is to adjust the context for mental content (Teasdale et al., 2002), with less emphasis on changing the nature of that content. That is, MBCT encourages the reframing of maladaptive mental content (e.g., curiously observing and acknowledging without engaging or avoiding) without directly trying to alter it (e.g., modifying irrational beliefs to be more rational). MBCT teaches individuals to accept and experience their negative beliefs and emotions, but not to dwell on them and to focus on the present moment. This emphasis on cognitive context over content is emblematic of theories about mindfulness (e.g., Brown et al., 2007; Hayes, 2004; Shapiro et al., 2006).

The context-oriented approach of MBCT can be characterized as an *activation-deactivation* model rather than an accommodation model (Hollon et al., 1990). In the activation-deactivation model, certain mental contexts prevent recurrent depressive or

anxious symptoms by deactivating negatively biased schemas. Recall that in MBCT, a metacognitive stance reframes how mental information is processed so that it is not automatically pursued (Scherer-Dickson, 2004). When a trigger – a sad mood or an anxiety-provoking situation – occurs, then negatively biased reaction patterns can be recognized and intentionally processed as mental phenomena without necessarily subscribing to or identifying with them (Segal et al., 2002). This can prevent further cognitive elaboration on them. Within the activation-deactivation model, this prevents the continued activation of the biased schema that would otherwise occur by either (a) automatically following schema-determined thoughts and feelings as usual, or (b) actively challenging them as may occur in traditional cognitive therapy. By preventing the continued activation of negatively biased schemas, they may have less impact in the present. Over time, it is conceivable that their initial activation could be reduced.

Interestingly, this suggests that adjusting mental context can have implications for cognitive content, even though mental content itself is not the focus in mindfulness-based approaches such as MBCT. To deactivate a schema, *compensatory* schemas may be activated (Hollon et al., 1990). Compensatory schemas provide alternate, more adaptive skills for dealing with stressors. Mindfulness skills comprise a compensatory schema. Practicing the metacognitive, present-moment perspective of mindfulness, negatively biased cognitive patterns can be acknowledged with acceptance while attention can be redirected toward the actual qualities of each moment as it unfolds (Garratt et al., 2007; Segal et al., 2002; Sherer-Dickson, 2004). This suggests that cognition would be less

occupied with negatively biased thoughts and more focused on openly noticing aspects of what is actually occurring, such as the details of one's sensations or environment.

Consistent with this approach and cognitive theory overall, Segal and colleagues (2002) do provide some explanation of the relationship between a mindful context and mental content in individuals with depressive or anxious tendencies. They describe that for these individuals, normal classification of incoming stimuli as pleasant or unpleasant can trigger mind-wandering into biased elaborations such as distorted interpretations. Using mindfulness to reduce such mind-wandering and recognize such elaborations, fewer schematic attachments are affixed to basic observations and more attention can be given to what is actually occurring. Segal and colleagues add that this process has the potential not only to reduce exaggerations of negative events but also to increase awareness of pleasant events. With this explanation, they imply that the context-oriented approach of MBCT, and of mindfulness in general, can affect mental content so that it is less affected by negativity biases and instead occupied with other information.

In sum, mindfulness-based approaches such as MBCT may alter cognitive content even though they are focused on context. Further, it should be noted that the perspective-taking process of traditional CT may alter cognitive context in order to change cognitive content. Indeed, some have asked if mindfulness-based approaches actually differ from traditional CT or if they simply call attention to context (Garratt et al., 2007). Although the approaches undoubtedly are related, CT differs from mindfulness-based approaches in that it may actively employ and reinforce cognitive elaboration by directly evaluating cognition; therefore, it may sway toward mental preoccupation and endorsing certain

biases over others. On the other hand, mindfulness-based approaches offer a unique process of reducing elaboration and attending to the present. This may enable individuals to be less influenced by or susceptible to negativity biases. Hence, it would be useful to know if mindfulness does reduce negativity bias and if this is a mechanism through which mindfulness prevents or reduces emotional distress.

Mechanisms of Mindfulness

Before turning to reduced negativity bias as a potential mechanism of mindfulness, it is important to consider existing evidence on possible mechanisms of mindfulness. Research on such mechanisms is just beginning to develop (Arch & Craske, 2006; Shapiro et al., 2006). That which has been done centers largely on emotional reactivity and rumination without directly considering cognitive biases.

First, it has been proposed that mindfulness reduces emotional reactivity. That is, mindfulness may attenuate the extremity of affective experience which, in turn, reduces the likelihood of depression and anxiety. Arch and Craske (2006) found that participants who underwent a 15-minute focused breathing induction (modeled on a mindfulness exercise) reported significantly less negative emotion in response to negatively valenced pictures compared to those who received a worry or unfocused attention induction. The authors suggested that these results indicated faster recovery or less emotional reactivity after exposure to negative stimuli. Similar conclusions have been drawn from studies that tested the effect of acceptance-oriented inductions on coping with an aversive situation, breathing carbon dioxide enriched air (Eifert & Heffner, 2003; Levitt, Brown, Orsillo, & Barlow, 2004). These studies found that participants in the acceptance

induction condition reported less subjective anxiety and displayed less behavioral avoidance compared to a controlled-breathing induction condition (Eifert & Heffner, 2003), and to suppression and control conditions (Levitt et al., 2004). Another study (Broderick, 2005) found that brief mindfulness meditation improved recovery from an induced sad mood. Further, a mixed-design study by Ortner, Kilner, and Zelazo (2007) also was discussed in terms of emotional reactivity. They examined attentional control in emotional contexts, comparing three conditions: two groups that were trained for seven weeks in either mindfulness meditation or body awareness/relaxation, plus a waiting-list control group. A measure of emotional interference that assessed reaction times on a cognitive task during the presentation of positive, neutral or negative pictures was administered before and after the seven weeks. Only the mindfulness meditation group showed a significant reduction in the time used to disengage from unpleasant pictures to respond on the cognitive task.

Some researchers (e.g., Brown et al., 2007) suggest that such findings may indicate that emotional evenness rather than reactivity is inherent in mindfulness based on its "non-evaluative aspect" (p. 220). Although meditation practices reduce autonomic arousal (Takahashi, 2005) and mindfulness may reduce identification with particular emotional responses (Segal et al., 2002), characterizing mindfulness as minimizing affectively valenced reactions and as being non-evaluative is questionable. First, other research suggests that increased present-moment attention can maintain or increase sensitivity to the valence of an experience in the moment (e.g., Cioffi & Holloway, 1993; LeBel & Dubé, 2001) and that mindfulness is associated with increased compassion

(Neff, 2003). Moreover, describing mindfulness as non-evaluative may be problematic because mindfulness would not be adaptive if it precluded all discernment. The nondiscriminatory property of mindfulness pertains to remaining open to and curious about all information, including affective information and evaluative reactions, with attentional flexibility. Likewise, Nielsen and Kaszniak (2006) found that Buddhist meditators displayed increased awareness and clarity of emotions including improved valence discrimination. Indeed, Ortner and colleagues' (2007) findings provide evidence of attentional flexibility resulting from training in mindfulness meditation. Further, a study by Wenk-Sormaz (2005) provided preliminary evidence that meditation training may reduce habitual responding. Such results support the contention here that mindfulness produces more clearly informed, less biased appraisals rather than habitually biased reactions, which could produce greater equanimity when appropriate but differs from the idea that mindfulness simply attenuates affective reactions.

In fact, it is possible that all of the above findings used to support the emotional reactivity explanation could be due to the alternative explanation that participants' overall evaluations were less affected by a bias toward overemphasizing negative information (forms of this bias are also common to some degree in nonclinical populations; cf. Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001). Arch and Craske (2006) found that the focused breathing condition reported less negative responses to neutral slides compared to the unfocused attention and worry conditions. Similarly, Ortner, Kilner, and Zelazo (2007) found that only mindfulness meditation training (and not the other conditions) led to a decrease in negativity ratings of unpleasant stimuli. In the study by

Eifert and Heffner (2003), participants in the acceptance-induction condition rated the aversive situation as less unpleasant than did the comparison group. Levitt and colleagues (2004) reported that participants in their acceptance-induction condition did not evaluate their physical symptoms as negatively as did those in the other two conditions. In sum, all of these results suggest that mindfulness-based inductions changed participants' evaluations – perhaps so that negative information was not weighted as heavily – which could explain why participants appeared less emotionally reactive.

A second proposed mechanism to the benefits of mindfulness is that mindfulness reduces rumination, which is associated with emotional disorders. Measures of trait mindfulness negatively correlate with rumination (e.g., Brown & Ryan, 2003; Cardaciotto, 2008). Coffey and Hartman (2008) found that rumination partially mediated a relationship between trait mindfulness and lower psychological distress. Among many experimental studies, Ramel, Goldin, Carmona, and McQuaid (2004) found that MBSR participation decreased rumination, and this accounted for some improvement in additional cognitive and affective variables. Similarly, Jain and colleagues (2007) found that mindfulness meditation training reduced rumination, which in turn partially mediated a reduction in reported distress. Furthermore, this effect of mindfulness meditation on rumination was not due to relaxation, given that a comparison group trained in relaxation did not experience significantly reduced rumination.

Mindfulness is antithetical to rumination because rumination dwells in thoughts and feelings about the past and future whereas mindfulness witnesses moment-by-

moment experience as it unfolds. The self-perpetuating nature of the dwelling that characterizes rumination is itself problematic (Segal et al., 2002); however, a key aspect of this dwelling is that it is negatively biased. For example, dwelling in the form of increased rehearsal of information in an unbiased manner, such as carefully studying for an exam or preparing a presentation, is not harmful. An important aspect of mindfulness in terms of rumination may be that by reducing the tendency to dwell on and identify with negative thoughts, negative schemas are engaged less and compensatory skills are used that decrease bias. In turn, stimuli can be evaluated more objectively (when evaluation is appropriate), perhaps reducing the amount of negatively-oriented concerns and increasing awareness of positive qualities. Again, a shift in cognitive functioning toward more unbiased processing may explain the association between rumination and mindfulness.

The proposed mechanism in this thesis, that mindfulness reduces bias, has not been examined directly but has been suggested by some research. First, a theory recently proposed by Shapiro and colleagues (2006) to explain the mechanisms of mindfulness suggests that a fundamental, overarching mechanism for other mechanisms is "reperceiving." This is described as a process of stepping back "from the contents of consciousness (i.e., one's thoughts)" and viewing "his or her moment-by-moment experience with greater clarity and objectivity" (p. 377). They continue: "Reperceiving, in which there is increasing capacity for objectivity in relationship to one's internal/external experience, is in many ways the hallmark of mindfulness practice" (p. 378). In other words, mindfulness reduces biases in attention to and processing of

information. Shapiro and colleagues did not provide direct evidence of such reduced bias, but other research provides some indirect support.

The study by Ramel and colleagues (2004) aimed to examine the effects of MBSR on cognition. They focused on rumination because it, like mindfulness, creates a context for cognition. However, they did include a measure of dysfunctional attitudes, an important measure of bias in emotional disorders, and reported significant improvements on this measure resulting from the intervention. Another measure of bias was included in a study by Heppner et al. (under review) on mindfulness and aggression. They found that trait mindfulness was associated with less biased perceptions of hostile intent in socially ambiguous situations.

Herndon (2008) studied trait mindfulness in relation to two cognitive factors that could be related to bias: external encoding, a measure of thoroughness in attending to the external environment, as well as cognitive failures, a measure of common errors from failing to notice things. A moderate positive correlation was found between trait mindfulness and external encoding. Additionally, strong negative correlations were found between mindfulness and cognitive failures including memory, distractibility and blunders. Herndon thus suggests that mindfulness could reduce errors that are due to self-focus biases and inflexibility when interpreting one's environment. This explanation does not acknowledge that self-focus may not be detrimental when it simply involves internal state awareness rather than ruminative self-consciousness (e.g., Trapnell & Cambell, 1999), and mindfulness seems to involve only the former (Brown & Ryan, 2003). Further, it has been suggested that this more adaptive type of self-focus in

mindfulness integrates better with externally focused attention (Brown et al., 2007). Regardless, Herndon's results, along with those of Ramel et al. and Heppner et al., support that mindfulness may foster objectivity and reduce bias.

Additional indirect support comes from suggestions that mindfulness may be characterized by less ego-involvement as indicated by less defensive behavior. Heppner and Kernis (2007) suggest that the processes involved in being mindful "quiet the ego" (p. 248). That is, they prevent self-worth from being linked to or threatened by everyday affairs. They provide initial evidence for this in their research linking mindfulness to reduced aggressiveness (Heppner et al., under review) and verbal defensiveness (Lakey, Kernis, Heppner, & Lance, 2008). Similarly, Leary, Adams, and Tate (2006) suggest that mindfulness promotes "hypo-egoic functioning" (p. 1822) by decreasing abstract thoughts about the self and increasing concrete thoughts on one's current situation. Building on this hypothesis, they suggest that mindfulness may improve self-regulation by helping people to accept and engage reality. While more research is needed on such ideas, they suggest that by being less self-defensive, more mindful individuals may experience more openness to current reality. This could also imply that adjustments to thought content occur with less effort or internal conflict. In interventions like MBCT, this may facilitate the reduction in negativity biased cognition that is key in CT. Research directly testing this proposed mechanism is warranted.

Mechanisms: Methodological Issues

One likely reason that the relationship between mindfulness and bias has not received more direct empirical attention is simply the nascence of research on

mindfulness as an isolated construct rather than as part of a larger intervention. Self-report scales are the primary measures of mindfulness, and these were developed and tested only recently. Moreover, some disagreement exists over how to operationalize the construct (e.g., Bishop, 2002; Grossman, 2008). For example, the Mindful Attention Awareness Scale (Brown & Ryan, 2003) is a unidimensional measure of present-centered attention and awareness based on reverse-scored items describing inattentiveness. Although this scale could be critiqued as reductionistic (Grossman, 2008), in comparison to many others this measure may better reflect the core of traditional Buddhist conceptualizations. On the other hand, the Kentucky Inventory of Mindfulness Skills (KIMS; Baer, Smith, & Allen, 2004) and the Five Factor Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) are multidimensional measures including the following factors: observing, describing, acting with awareness, accepting without judging, and – for the FFMQ – nonreactivity to inner experience. These scales reflect some Western practitioners' preference for a multidimensional measure that mirrors the skills taught in many mindfulness-based interventions; however, these factors may extend beyond traditional notions of mindfulness and some of the factors overlap with each other. Perhaps finding some middle ground, Cardaciotto and colleagues (2008) just developed the Philadelphia Mindfulness Scale (PHILMS), a bidimensional measure of two key components that are found in most Western definitions of mindfulness and appear to contribute to mental health: present-moment awareness and acceptance. The different measures of trait mindfulness tend to correlate with each other, but the magnitude varies (Cardaciotto et al., 2008; Grossman, 2008).

Similar challenges are found in laboratory-based inductions attempting to manipulate mindfulness. Because true mindfulness requires training over time, approximations of mindfulness are used for efficiency and to explore the effects of simple instructions on novices. These proxies for mindfulness, such as Arch and Craske's (2006) "focused breathing" induction, LeBel and Dubé's (2001) "sensory focusing" induction, and Eifert and Heffner's (2003) "acceptance" induction, emphasize somewhat different aspects of mindfulness.

In sum, multiple operationalizations now exist to study the construct but some differences have yet to be resolved. This limitation may be most problematic to those with extensive experience in Buddhist psychology; some criticize all existing measures because mindfulness "is not to be fully comprehended by discursive, theoretical, or intellectual thinking but primarily relies on practical introspective practices considered undeveloped in most inexperienced individuals" (Grossman, 2008, p. 405). Nonetheless, most Western researchers seem to find practical value and relevance – as well as converging evidence – in the progress that has been made and call for more research on the mechanisms of mindfulness (e.g., Brown et al., 2007; Shapiro et al., 2006).

A Social Psychological Approach: Attitudinal and Attributional Biases

Another potential reason that biases have not been studied in relation to mindfulness is that certain types of biases tend to be studied in domains outside of applied clinical psychology, which has been the primary area of mindfulness research. Biases have been referred to broadly here thus far, but they may occur in various cognitive processes. Two well-established domains of social psychological research, in

which cognitive biases have been examined and linked to depression and anxiety, will be the focus of the present research: attitudes, which will be the primary consideration, and attributions.

Attitudes are summary evaluations made toward some object (Zanna & Rempel, 1988), which can be any object including the self. These summary evaluations are items of knowledge associated with an object (cf. Fazio, 2007) that vary on a positive to negative continuum, such as good/bad, desirable/undesirable, approach/avoid, and so forth (Breckler, 1984). According to the tripartite model as described by Zanna and Rempel, attitudes may be based on affective, cognitive and/or behavioral information. Because attitudes by their very nature involve a range from positive to negative, examining attitudes is very useful for uncovering biases toward negativity (or positivity, for that matter).

It is unsurprising, then, that negatively-oriented attitudes are characteristic of the cognitive biases found in depression and anxiety (Garratt et al., 2007; Kopp, 1989). In the clinical literature, attitudinal bias often is measured with self-report instruments like the Dysfunctional Attitudes Scale (DAS; Weissman & Beck, 1978), which assesses the extent to which one's self-evaluations are based on inflexible and unrealistic standards. Such measures can be useful. At the same time, they are subject to self-presentational concerns and are based on specific scenarios. That is, individuals may not provide honest responses on self-report measures because of motivations to present themselves in a certain light or to meet the expectations of the person distributing the measure (Miller, Doob, Butler, & Marlowe, 1965); further, the specific scenarios use particular domain-

relevant biases as indicators of negativity bias rather than assessing if an overall negativity bias is involved in the process of forming attitudes. However, at least one social psychological approach is now available that provides a cleaner test of overall negativity bias in attitude formation.

Fazio, Eiser, and Shook (2004) developed a new technique, a computer "game" called BeanFest, to assess attitude formation through associative learning: learning to associate a positive or negative valence with an object. Participants are instructed that they will find themselves in an imaginary world of beans, and their goal is to learn which beans are good and which beans are bad in order to succeed at the game. One of the unique advantages of this paradigm is that the beans are completely novel targets for evaluation. Participants have no prior knowledge of the beans, so learning and attitude formation can be assessed without motivational concerns or prior experience affecting the measurement. The beans vary in appearance (i.e., shape and number of speckles) and valence. In order to prevent participants from easily learning about the bean world, the beans were created carefully so that there is not a simple, linear rule (e.g., all circular beans are positive) by which participants can associate the appearance of the bean with its valence. To maintain and gain points in the game, participants must learn which individual beans are positive and which are negative. Beans are presented one at a time, and participants choose whether to select (approach) or not select (avoid) each bean. After participants make their decision, they are provided with feedback informing them

of the specific bean's valence.[1] If they chose to select the bean, they earn 10 points if it was positively valenced, but they lose 10 points if it was negatively valenced. If they chose not to select the bean, their score remains unchanged. Half of the beans are positive and half are negative. Thus, all participants, regardless of their game scores, experience an equal amount of information about – and equal opportunities to learn – positive and negative stimuli. Specifically, each game bean is presented three times, so participants have three opportunities to learn each bean during the game.

Learning of the valence of each bean is assessed in a test phase after the game phase. During the test phase, individual beans are presented and participants simply categorize them according to valence. No points are involved and no feedback is provided. If participants correctly identify the valence of more negative beans from the game than positive beans, this demonstrates negatively biased learning of attitudes: learning negative evaluations better than positive evaluations. Importantly, this specific negativity bias has been associated with negative cognitive styles and predisposition to depression and anxiety (Shook, Fazio, & Vasey, 2007).

In addition to beans presented during the game, the test phase also includes beans that are systematically similar to the game beans but were not presented in the game; this assesses generalization of learned attitudes to similar but novel stimuli. In their original studies, Fazio, Eiser, and Shook (2004) found a robust tendency for individuals to generalize negative attitudes to a greater extent than positive attitudes. Moreover, this

[1] This describes the version of the game that will be used in this study because of its established relevancy to the cognitive biases found in those who are predisposed to depression and anxiety (Shook, Fazio, & Vasey, 2007). However, another version of the game does exist in which feedback is contingent upon bean

generalization asymmetry was apparent when learning was controlled, so the generalization bias was not simply a by-product of negatively biased learning. Negatively biased generalization of attitudes, after accounting for the learning bias, has also been observed in individuals predisposed to depression and anxiety (Shook & Fazio, unpublished data). Individuals who were more predisposed to depression and anxiety tended to exhibit greater generalization of negative attitudes. In sum, research using BeanFest has found that individuals who are predisposed to depression and anxiety learn negative attitudes better than positive ones (Shook et al., 2007), and they also are more likely to evaluate a similar but unknown target negatively. In particular, they fail to learn to appreciate positive stimuli. These results provide clean, objective evidence of a negativity bias occurring during the process of attitude formation.

BeanFest may be an especially useful tool for examining the implications of mindfulness on cognitive content as it relates to depression and anxiety. It has been proposed here that mindfulness may alter cognitive content so that it is less biased, by disengaging from (deactivating) negative schemas and re-directing cognition to a wider, more curious observation of current experience. All aspects of experience, positive and negative (or neutral), should be acknowledged as they are. Such improved objectivity could be revealed through more accurate learning and generalization of the valence of both positive and negative stimuli within the BeanFest paradigm. If that were the case, this may suggest that mindfulness enables evaluative abilities to be deployed more adaptively, rather than in the biased fashion that characterizes depression and anxiety.

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selection. Such a format provides interesting information about exploratory behavior but does not isolate

Besides negativity biases related to attitudes, negatively biased attributions, or inferences about the causes and implications of events, have also been highlighted as a significant part of the negative cognitive style in depression and anxiety (Garratt et al., 2007; Fresco, Alloy, & Reilly-Harrington, 2006). Specifically, individuals with depression or anxiety tend to attribute negative life events to internal, stable and global causes (Fresco et al., 2006). Such attributions typically are measured using self-report instruments that ask participants to imagine themselves in specific scenarios and then to indicate the causes and implications. Although these measures have the same drawbacks mentioned for the self-report attitudinal measures, they would provide additional evidence of less biased cognition in relation to mindfulness. The association between mindfulness and thoroughness in attending to external information (Herndon, 2008) suggests that mindfulness would reduce biases toward internal attributions for negative life events. Combined with the present-moment orientation of mindfulness, this increased external encoding should also enable attributions toward temporary and context-specific causes rather than stable and global ones. Thus, there is evidence to suggest mindfulness may reduce the attributional biases that characterize depression and anxiety. Demonstrating this would further suggest that mindfulness reduces bias.

The current research aimed to determine whether reduced negativity bias is a feasible mechanism by which mindfulness practices reduce emotional disorders. Two studies were designed to test the link between mindfulness and negativity bias. Specifically, the current research examined how mindfulness affected attitude formation

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the cognitive bias that is relevant to the current study.

in BeanFest as well as self-report measures of attitudes and attributions. These measures were selected to indicate if mindfulness fosters less biased and more adaptive evaluative and inferential processes, providing a direct empirical test of the notion that mindfulness entails less bias. This may explain why mindfulness helps to alleviate depression and anxiety: It may facilitate a correction of negatively biased cognitive content without requiring cognitive elaboration or direct restructuring. As such, the current work may have significant implications for clinical practices and it may also point to additional benefits of mindfulness for relating to the self and the social world.

Present Studies

Two studies were conducted to test if mindfulness reduces negatively biased cognition. The first study aimed to establish correlational relations between trait mindfulness and the aforementioned measures of bias in attitudes and attributions, with a focus on attitude formation. First, it was predicted that as trait mindfulness increases, accuracy in attitude formation (both learning and generalization in BeanFest) would also increase. That is, more mindful individuals would learn negative and positive beans more equally (i.e., exhibit less of a negative learning bias) and would exhibit more equivalence in generalizing positive and negative attitudes (i.e., exhibit less of a negative generalization bias). As mindfulness was proposed to reduce bias overall, it was not expected that mindful individuals would show a reversal of the learning and generalization biases (i.e., better learning of positive beans and more generalization of positive attitudes). It was further hypothesized that this increased accuracy in attitude formation would mediate inverse relationships between trait mindfulness and both

depression and anxiety. Finally, to provide further support for the proposed relationship between mindfulness and reduced biases, mindfulness was also expected to inversely correlate with measures of dysfunctional attitudes and attributions that characterize a negative cognitive style, which would also mediate the anticipated mindfulness-emotional disorder relationship.

After establishing correlational relationships, an experimental framework was used in the second study to test the causal link between mindfulness and reduced negativity bias. A mindfulness-based laboratory induction was compared with a control induction for effects on attitude formation and cognitive style. It was expected that the mindfulness condition would show more accurate learning and generalization of object valence than the control condition. Specifically, it was predicted that compared to the control condition, individuals in the mindfulness-induction condition would learn negative and positive beans more equally (i.e., exhibit less of a negative learning bias, without reversing to a positivity bias) and would exhibit more equivalence in generalizing positive and negative attitudes (i.e., exhibit less of a negative generalization bias, without reversing to a positivity bias). Effects on the additional measures of negative cognitive style, including attitudes and attributions, also were explored. Again, participants in the mindfulness condition were expected to demonstrate less negatively biased processing.

CHAPTER 2 Study One

The purpose of the first study was to demonstrate the associations between mindfulness, negativity bias, and emotional disorders. As this was a first step in specifically testing reduced negativity bias as an underlying mechanism to the benefits of mindfulness, Study One was correlational in nature. Negativity bias was measured using several cognitive style questionnaires which assessed attitudes and attributions. In addition, the BeanFest paradigm was used as a more covert measure of biased processing in attitude formation and attitude generalization. Emotional disorders were assessed with several commonly used depression and anxiety scales. Finally, two measures of trait mindfulness were used.

It was hypothesized that mindfulness would be inversely correlated with negativity bias, positively correlated with accuracy (in BeanFest), and negatively correlated with depression and anxiety. Specifically:

1. Trait mindfulness was expected to positively correlate with equivalent learning and equivalent generalization of positive and negative valences in BeanFest, as this would indicate more accurate attitude formation and generalization. Stated in terms of bias, mindfulness was expected to predict less asymmetrical attitude formation and less negatively biased generalization of attitudes.

2. Trait mindfulness was predicted to inversely correlate with negativity biases in self-report measures of both attitudes and attributions.

3. Trait mindfulness was anticipated to inversely correlate with self-report measures of depression and anxiety.

4. The expected inverse relationship between mindfulness and emotional disorders was predicted to be mediated by less negativity bias.

Method

Participants

A convenience sample of 191 undergraduate psychology students was recruited using the university's online study recruitment system, Sona. A power analysis (Cohen, 1992) based on .80 power, an alpha level of .05, and a medium effect size had determined a necessary sample size of 177. Students participated for extra course credit. The study topic was advertised as "Personality and Games" to conceal the hypotheses and to incite interest. Those under 18 years of age and those who had participated in other studies using BeanFest were not eligible to participate.

Eight participants' data were excluded: three because of technical issues (e.g., computer freezing), two who did not speak English sufficiently, and three who did not follow directions and take the study seriously (e.g., using the same response key for every questionnaire item). Thus, the final sample size was 183. Over half of the participants were male (59%), and the mean age was 19.4 years (SD = 3.4). The sample was fairly diverse, with 55% identifying as 'White,' 23% 'African American/Black,' 11% 'Asian,' 7% 'Hispanic/Latino,' and 7% 'Other.'

Measures

BeanFest. Attitude formation and attitude generalization were assessed with BeanFest (Fazio, Eiser, & Shook, 2004). From a participant's standpoint, BeanFest appears to be a computer game set in an imaginary world of beans that vary in appearance. Participants choose to select or not to select individual beans. After choosing, they see the bean's point value: either +10 points (positively valenced) or -10 points (negatively valenced). If they selected the bean, then their score – which starts at 50 points and may range from 0 to 100 points – adjusts accordingly. If they did not select the bean, then their score remains unchanged.

The beans differ in shape (circular to oval to oblong) and in number of speckles (1-10), as presented by the matrix of 100 possible shape-speckle combinations in Figure 1. From this matrix, six regions of beans (36 beans total) were carefully selected for inclusion in the game. The regions were created so that no linear relationship exists between the shape or speckles of the bean and its valence. This ensures that participants must learn the valence of each bean individually rather than learning a simple rule that would explain the valence of multiple beans.

After a practice round in which participants view one bean from each of the six regions, participants proceed through three blocks of the game. In each block, the 36 game beans are presented individually, in random order. Whether or not the participant selects the bean, feedback about the valence of the bean is provided to ensure equal learning opportunities for all 36 beans. By providing feedback about all beans, information gain is not dependent on game behavior and a bias in learning can be assessed more purely. After the game phase is complete, a test phase assesses learning

and generalization of the valence of the beans. In this test phase, each of the 100 beans from the matrix is presented in random order. The participant is simply asked to categorize the bean as "good" (increases points when selected) or "bad" (decreases points when selected). No feedback is provided during this phase. Responses to the 36 game beans indicate learning. Responses to the remaining 64 beans indicate generalization to similar but novel stimuli.

To assess learning biases, the proportion of positive game beans learned correctly was subtracted from the proportion of negative game beans learned correctly. A positive difference indicates negatively biased learning. No bias – equal learning of positives and negatives – results in a zero difference. In addition, each proportion (positive and negative beans learned correctly) can be examined to reveal if a learning bias is due to exceptional learning of one valence or to poor learning of the other valence.

To assess the overall generalization bias, positive responses to the novel beans were coded as -1, whereas negative responses were coded as +1. Responses to the 64 novel beans were averaged to represent overall generalization. With this coding scheme, positive numbers represent greater generalization of negative attitudes, or more negativity bias, and negative numbers represent greater generalization of positive attitudes. Unbiased generalization is represented by a mean around zero, equivalence between the number of novel beans classified as positive and negative.

Number of speckles: 1-10

		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Circular	X1	1	1	1			-1	-1	-1		
	X2	1	1			-1	-1	-1			
	X3						-1				
	X4									1	
Oval	X5		-1						1	1	1
	X6	-1	-1	-1						1	1
	X7	-1	-1								
	X8					1					
	X9				1	1	1			-1	-1
Oblong	X10			1	1	1			-1	-1	-1

1: Positive bean (+10 points)

-1: Negative bean (-10 points)

Figure 1. Matrix of shape-speckle combinations and six regions of game beans in BeanFest

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Mood state was assessed to ensure that relationships between the variables of interest were not due to participants' current mood. This commonly used self-report measure is comprised of two subscales that assess two global dimensions of affect, positive and negative. Participants rate each of 20 adjectives (e.g., enthusiastic, distressed) using a 5-point scale ranging from 1 (*very slightly or not at all)* to 5 *(very much)*, to indicate the extent to which they are currently experiencing the descriptor. Scores for each subscale are totaled, with higher scores indicating higher positive or negative affect. The PANAS has shown good convergent and discriminant validity, test-retest reliability, and internal consistency (for Study 1, $\alpha = .89$ for positive affect and $\alpha = .83$ for negative affect; for Study 2, $\alpha = .87$ for positive affect and $\alpha = .86$ for negative affect).

Dysfunctional Attitudes Scale (DAS; Weissman & Beck, 1978). The DAS was used as a measure of negative cognitive style. It is a 64-item self-report measure of cognitive distortions based on Beck's cognitive theory (1987) of depression. The items represent implicit rules and conditions that involve inflexible or unrealistic standards for oneself. Each statement is rated on a 7-point scale ranging from 1 (*totally agree)* to 7 (*totally disagree)*. Higher scores indicate a greater degree of dysfunctional cognitions. Example items include "I should be happy all the time," and "I am nothing if a person I love does not love me." The DAS has shown good convergent validity, test-retest reliability, and internal consistency (for Study 1, $\alpha = .87$; for Study 2, $\alpha = .91$).

Looming Maladaptive Style Questionnaire (LMSQ; Riskind, Williams, Theodore, Chrosniak, & Cortina, 2000). This is a measure based on the Looming Vulnerability Model (LVM; Riskind, 1997; Riskind, Williams, & Joiner, 2006) of anxiety. It assesses the tendency to create mental representations of potentially threatening situations that are rapidly rising in risk or intensifying in danger. Participants read six short vignettes describing potentially stressful situations and then complete three questions for each vignette on 5-point scales. The three questions ask whether the chances of having a difficulty seem to be decreasing or expanding with each moment, if the level of threat seems fairly constant or is growing rapidly larger with each moment, and how much they visualize their problem as not changing or in the act of becoming progressively worse. Responses to the three questions for the six vignettes are combined to produce a total score. The LMSQ shows adequate validity, test-retest reliability, and internal consistency (for Study 1, $\alpha = .70$; for Study 2, $\alpha = .73$).

Future Events Scale (FES; Anderson, 1990). A final measure of biased cognitive processing is comprised of two subscales measuring optimism and pessimism based on the perceived likelihood of specific positive and negative future events. It is composed of 26 items describing 13 positive events and 13 negative events. Using an 11-point scale ranging from -5 *(extremely unlikely)* to +5 *(extremely likely)*, participants rate the likelihood of each event happening to them at some point in their lives. Ratings were totaled for each subscale. Higher scores indicate more optimistic or pessimistic outcome expectancies, depending on the subscale. This scale shows good convergent and discriminant validity, test-retest reliability, and internal consistency (for Study 1, $\alpha =$. 88 for optimism and $\alpha = .81$ for pessimism; for Study 2, $\alpha = .90$ for optimism and $\alpha =.77$ for pessimism).

Beck Depression Inventory –II (BDI; Beck, Steer, & Brown, 1996). The BDI is a routinely used self-report measure designed to assess the intensity of affective, cognitive, motivational, and physiological symptoms of depression.[2] It consists of 21 items, each of which contains 4 self-evaluative statements that range in intensity on a 4-point scale from 0 to 3. For example, an item called "Past Failure" ranges from "I do not feel like a failure" (0) to "I feel I am a total failure as a person" (3). Total scores can range from 0 to 63. The BDI-II has good psychometric properties (Beck, Steer, Ball, & Ranieri, 1996) including internal consistency (for Study 1, $\alpha = .89$).

State-Trait Anxiety Inventory (STAI; Spielberger, 1983). The STAI is a widely used self-report instrument that contains two subscales to measure state and trait anxiety.

Each subscale consists of 20 items, which are rated on a 4-point scale of intensity for the state subscale and a 4-point scale of frequency for the trait subscale. Participants complete the state subscale followed by the trait subscale. A sample item from the state subscale is "I am jittery," and a sample item from the trait subscale is "I worry too much over something that really doesn't matter." Each subscale shows good internal consistency (for Study 1, $\alpha = .91$ for the trait subscale and $\alpha = .92$ for the state subscale; for Study 2, $\alpha = .92$ for the state subscale)

Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988). The BAI is a unidimensional self-report measure of trait anxiety. It was developed specifically to measure severity of anxiety and to discriminate anxiety from depression. The inventory consists of 21 items stating common symptoms of anxiety (e.g., terrified, hands trembling), which are rated on 4-point scales ranging from 0 (*not at all)* to 3 (*severely*). Total scores can range from 0 to 63. The BAI shows adequate validity and internal consistency (for Study 1, $\alpha = .90$).

Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003). The MAAS is a unidimensional self-report measure of present-moment oriented attention and awareness. It contains 15 items scored on a 6-point scale from 1 (*almost always*) to 6 *(almost never*). Example items include: "I find it difficult to stay focused on what's happening in the present" and "I find myself doing things without really paying attention." Item scores are totaled; higher mean scores reflect higher mindfulness. This widely used scale shows adequate psychometric properties such as convergent and

[2] The BDI includes items that indicate suicidal intentions. Participants who reported such intentions were

discriminant validity as well as test-retest reliability and internal consistency (for Study 1, $\alpha = .91$; for Study 2, $\alpha = .84$).

Philadelphia Mindfulness Scale (PHILMS; Cardaciotto et al., 2008). The PHILMS is a bidimensional self-report measure of present-moment awareness and acceptance, or receptivity, toward experiences. It contains 20 items, 10 per component, rated on a 5-point scale from 1 (*never*) to 5 (*very often*). An example item from the awareness subscale is "When I walk outside, I am aware of smells or how the air feels against my face." An example item from the acceptance subscale is "I tell myself that I shouldn't have certain thoughts." Scores are totaled, yielding a total mindfulness score and scores for each subscale. Higher mindfulness is indicated by higher total scores, and higher awareness and acceptance are indicated by higher scores on each respective subscale. This recently developed measure shows a strong two-factor solution, adequate convergent and discriminant validity, and respectable internal consistency for both subscales (for Study 1, $\alpha = .81$ for awareness and $\alpha = .86$ for acceptance).

Demographics. Demographic information describing the sample was collected, including gender, age, marital status, ethnicity, and religious affiliation. Additionally, participants were asked to report the amount of time they had spent practicing mindfulness meditation, transcendental meditation, yoga, tai chi, and similar practices.

Procedure

Participants were greeted by an experimenter and told that they would be participating in a study on personality and games. Up to six participants completed a

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identified and promptly referred to counseling. This limit to confidentiality was stated in the consent form.

session at one time, but they were seated at individual computer cubicles and did not interact. Informed consent was obtained by the experimenter before proceeding with the study procedures. Then, participants completed the BeanFest game and the questionnaires. All instructions, measures, and debriefing statements were administered on Dell Optiplex 745 computers, using the programs Inquisit and MediaLab. At the end of the session, participants were informed of the study's true purpose. Any questions were answered and the participants were thanked and dismissed.

Results

Preliminary analyses

Initial inspections of the data revealed six outliers: one for the Negative Affect subscale of the PANAS, one for the BDI, one for the BAI, one for the Pessimism subscale of the FES, and two for the Optimism subscale of the FES. Comparisons of the 5% trimmed mean to the overall mean for each of variables determined that these values significantly affected the mean, so they were excluded. After excluding these values, the distributions for all variables were normal.

Descriptive statistics

Descriptive statistics, including means, standard deviations and ranges, for all variables of interest can be found in Table 1. Measures of central tendency and variability for the affective, cognitive style, and mindfulness measures were consistent with previous findings.

For the BeanFest data, a phi coefficient between bean valence and test-phase categorization was calculated for each participant to indicate how well he or she learned

the valence of the game beans. The mean phi coefficient was .19 (*SD* =.26), which was significantly different from zero, $t(182) = 9.98$, $p < .001$, indicating that overall the participants did learn. The percent of positive beans correct (*M* =.59, *SD* =.15) and percent of negative beans correct (*M* =.60, *SD* =.18) both were significantly greater than chance (50 percent), $t(181) = 7.88$, $p < .001$ for percent positive correct and $t(181) = 7.44$, $p < .001$ for percent negative correct. The difference between these two indices – that is, the learning asymmetry – was .01, which a *t*-test showed to be equivalent to a zero difference, $t(181) = .73$, $p = .47$. Previous research (e.g., Fazio et al., 2004, study 2) based on the version of BeanFest used here (which provided feedback on bean valence after each trial) also has found nonsignificant learning asymmetries. Such experiments still found significant generalization asymmetries; similarly, the mean generalization asymmetry here of .03 (*SD* = .23) showed a marginally significant difference from zero, $t(182) = 1.96$, $p = .051$.

It should be noted that learning, as indicated by the mean phi coefficient and percents positive and negative correct, was lower in the current sample than in previous experiments. For comparison, previous research (Shook et al., 2007) using this version of BeanFest found a mean phi coefficient of .41 and percents positive and negative correct of .67 and .73, respectively. Further examination of the present data revealed that 30 percent of the sample had phi coefficients of zero or less, indicating no or incorrect learning. Potential reasons for this relatively low learning will be explored in the discussion.

Table 1

Means, standard deviations, and ranges for all variables of interest (Study 1)

Variable	Mean	SD	Range
BeanFest indices			
Learning[a]	.19	.26	1.24
Percent positive correct	.59	.15	.83
Percent negative correct	.60	.18	.89
Learning asymmetry[b]	.01	.22	1.44
Generalization asymmetry[c]	.03	.23	1.30
Cognitive style measures			
DAS	121.90	26.96	129.00
LMSQ	56.30	9.10	62.00
FES – Optimism subscale	26.15	16.07	83.00
FES – Pessimism subscale	-6.69	18.48	92.00
Affect measures			
PANAS – positive affect subscale	25.17	8.27	37.00
PANAS – negative affect subscale	16.42	5.61	25.00
BDI	12.46	9.11	42.00
BAI	13.38	9.70	44.00
STAI – trait subscale	42.06	11.39	51
STAI – state subscale	40.11	11.68	54
Mindfulness measures			
MAAS	3.89	.98	5.00
PHILMS (Total)	65.31	9.41	57.00
Awareness subscale	36.46	6.44	28.00
Acceptance subscale	28.85	7.64	40.00

DAS = Dysfunctional Attitudes Scale; LMSQ = Looming Maladaptive Style Questionnaire; FES = Future Events Scale; PANAS = Positive and Negative Affect Schedule; BDI – Beck Depression Inventory II; STAI = State-Trait Anxiety Inventory; BAI = Beck Anxiety Inventory; MAAS = Mindful Attention Awareness Scale; PHILMS = Philadelphia Mindfulness Scale

[a]Phi coefficient between actual valence of bean and participant's classification of the bean during the test phase.

[b]Learning asymmetry: Proportion negative correct minus proportion positive correct; reflects bias in attitude formation

[c]Generalization asymmetry: Number classified negative minus number classified positive; reflects bias/accuracy in generalization

Correlations: BeanFest indices and affective and cognitive style measures

Zero-order correlations between the BeanFest indices and the affective and cognitive style measures are shown in Table 2. The BeanFest indices all correlated significantly with one another, as anticipated. Those who reported more negative affect on the PANAS and state anxiety on the STAI exhibited poorer learning in BeanFest. Unexpectedly, percent negative correct was inversely associated with negative affect as well as with dysfunctional attitudes. Moreover, contrary to past findings, no other significant correlations were found between the BeanFest indices and the affective or cognitive style measures.[3]

Correlations: BeanFest indices and mindfulness measures

Nonetheless, two interesting correlations emerged in the correlational analysis of the BeanFest indices and the mindfulness measures (see Table 2). Overall learning was positively associated with mindfulness as measured by the MAAS.[4] That is, more mindful individuals learned bean valences better. MAAS scores also correlated significantly with percent positive correct, suggesting that better learning may have been due to greater learning of positives. Similarly, the correlation between the PHILMS and percent positive correct was marginally significant. These associations provide initial support for the idea that mindfulness enables greater attention to positively valenced stimuli.

[3] Partial correlations controlling for learning also did not replicate past relationships between these measures.

[4] Controlling for negative affect, the MAAS trended toward significant correlations with learning and percent positive correct.

Table 2

Zero-order correlations between BeanFest indices and cognitive style, affective, and mindfulness measures (Study 1)

	Learning	Percent positive correct	Percent negative correct	Learning asymmetry	Generalization asymmetry
Affect					
Positive affect	.04	.10	-.03	-.10	-.10
Negative affect	-.21**	-.08	-.22**	-.13†	-.06
BDI	-.12†	-.11	-.08	.01	.02
BAI	-.10	-.07	-.07	-.01	.00
STAI Trait	-.14	-.14	-.06	.05	.12
STAI State	-.23**	-.16†	-.16†	-.03	.06
Cognitive style					
DAS	-.14†	-.02	-.16*	-.11	-.10
LMSQ	-.06	-.08	-.02	.04	-.01
FES Optimism	-.11	-.10	-.07	.01	-.01
FES Pessimism	-.03	-.03	-.01	.03	.03
Mindfulness					
MAAS	.15*	.16*	.08	-.04	.07
PHILMS Total	.09	.13†	.02	-.07	-.03
Awareness subscale	.00	.03	-.01	-.03	-.02
Acceptance subscale	.11	.13	.03	-.06	-.02
BeanFest indices					
Learning					
Percent positive correct	.70**	--	--	--	--
Percent negative correct	.82**	.16*	--	--	--
Learning asymmetry	.20**	-.57**	.73**	--	--
Generalization asymmetry	.30**	-.16*	.52**	.55**	--

† $p < .10$, * $p < .05$, ** $p < .01$

Correlations: Affective and cognitive style measures

Table 3 contains the zero-order correlations between the cognitive style and affective measures. As expected, the measures of negative cognitive style (the DAS, LMSQ and FES Pessimism subscale) all correlated positively. These measures also inversely correlated with optimism as measured by the FES.

As in past studies, the BDI, BAI, and STAI were highly correlated with each other. Also as anticipated, these measures positively correlated with the measures of negative cognitive style and inversely correlated with the FES Optimism subscale.

All of these relationships remained significant when controlling for state affect.

Correlations: Mindfulness, affective, and cognitive style measures

Table 3 also lists the zero-order correlations between the mindfulness measures and the cognitive style and affective measures. In line with previous studies, the depression and anxiety measures were inversely associated with both measures of mindfulness (except that the BDI and STAI showed no relationship with the Awareness subscale of the PHILMS).

Supporting the hypotheses, measures of negative cognitive style inversely correlated with measures of mindfulness. Mindfulness measures also showed positive correlations with the FES Optimism subscale.

Controlling for state affect did not alter the above relationships.

Table 3

Zero-order correlations between affective, cognitive style, and mindfulness measures (Study 1)

	2	3	4	5	6	7	8	9	10	11	12	13	14
Affective measures													
1. Positive affect	.07	-.14†	-.12†	-.32**	-.25**	-.18*	-.16*	.26**	-.23**	.08	.28**	.13†	.23**
2. Negative affect	--	.39**	.35**	.43**	.54**	.42**	.16*	-.20**	.21**	-.23**	-.22**	-.02	-.25**
3. BDI	--	--	.92**	.73**	.63**	.30**	.27**	-.33**	.31**	-.47**	-.46**	-.13†	-.45**
4. BAI	--	--	--	.66**	.66**	.22**	.20**	-.33**	.28**	-.48**	-.42**	-.15*	-.40**
5. STAI Trait	--	--	--	--	.78**	.41**	.39**	-.46**	.43**	-.47**	-.60**	-.15†	-.57**
6. STAI State						.38**	.28**	-.43**	.42**	-.52**	-.48**	-.16†	-.44
Cognitive style measures				--									
7. DAS	--	--	--	--	--		.20**	-.33**	.29**	-.29**	-.36**	-.13†	-.33**
8. LMSQ	--	--	--	--	--		--	-.20**	.30**	-.18*	-.26**	.02	-.34**
9. FES Optimism	--	--	--	--	--		--	--	-.49**	.25**	.34**	.32**	.16*
10. FES Pessimism	--	--	--	--	--		--	--	--	-.33**	-.33**	-.04	-.38*
Mindfulness measures				--									
11. MAAS	--	--	--	--	--		--	--	--	--	.56**	.23**	.49**
12. PHILMS Total	--	--	--	--	--		--	--	--	--	--	.59**	.73**
13. PHILMS Awareness	--	--	--	--	--		--	--	--	--	--	--	.59**
14. PHILMS Acceptance	--	--	--	--	--		--	--	--	--	--	--	--

† $p < .10$, * $p < .05$, ** $p < .01$

Mediational analysis

The mediational analysis tested whether the inverse relationship between the mindfulness and depression/anxiety measures could be accounted for by the negative cognitive style measures, while controlling for state affect. (Because the BeanFest indices did not significantly correlate with the depression and anxiety measures, these were not included in the mediational analysis.)

For ease of presentation and considering the strong correlations among the three categories of questionnaires, composite variables for mindfulness, negative cognitive style, and depression/anxiety were computed as the mean of standardized scores on the relevant measures.[5] To meet the conditions for mediation, three relationships were necessary and found among the composite variables: (1) mindfulness correlated (inversely) with depression/anxiety, $r(177) = -.46$, $p < .001$, (2) mindfulness correlated (inversely) with negative cognitive style, $r(177) = -.39$, $p < .001$, and (3) negative cognitive style correlated with depression/anxiety, $r(177) = -.30$, $p < .001$. All of these relationships accounted for state affect. Given that the conditions for mediation were met, the next step was to test the relationship between mindfulness and depression/anxiety controlling for negative cognitive style (as well as state affect) to examine if doing so reduced the magnitude of the relationship. Accounting for negative cognitive style did decrease the magnitude of the correlation between mindfulness and depression/anxiety scores, $r(177) = -.39$, $p < .001$. Although the partial correlation remained significant, a Sobel's test (Baron & Kenny, 1986) revealed that the decrease

[5] The same results also were found using the individual measures.

was significant, $z = -3.36$, $p < .001$. Thus, the inverse relationship between mindfulness and depression/anxiety measures was partially mediated by negative cognitive style. The mediation model and results are depicted in Figure 2.

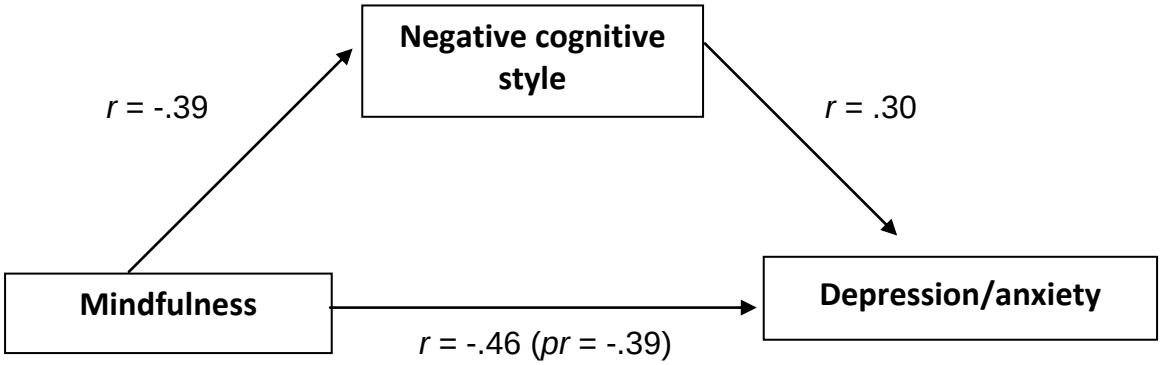

Figure 2. Mediation model and analysis (Study 1)

Discussion

The first study aimed to link greater mindfulness to less negativity bias on measures of attitude formation and negative cognitive style, and to examine if less negativity bias explains the inverse relationship between mindfulness and emotional distress. Trait mindfulness was associated with overall learning in the BeanFest game and specifically with learning positively valenced information, or forming positive attitudes. This provides initial support for the hypothesis that mindfulness is associated with less negativity bias. More support was found from the correlations between trait

mindfulness and negative cognitive style. Not only did mindfulness inversely correlate with all measures of negative cognitive style, this relationship partially accounted for the inverse association between mindfulness and emotional distress. That is, part of the reason that those who were higher in mindfulness reported less depression and anxiety appears to be that they experienced less negativity bias in cognition. Of course, other factors also must be considered to fully explain the relationship between mindfulness and emotional disturbance. Nonetheless, these initial findings suggest that cognitive content does differ for more and less mindful individuals.

Interestingly, trait mindfulness not only was associated with forming positively valenced attitudes but also was positively associated with optimism and negatively associated with pessimism. Together, these findings could indicate a positivity bias, which would run counter to the prediction that mindfulness is less biased overall (neither negatively nor positively biased). Inverse correlations with BeanFest learning and generalization asymmetries would have provided the clearest indication of positivity bias, but these were not found.[6] Unfortunately, because learning in BeanFest was relatively low and past findings were not replicated, it is difficult to draw firm conclusions from these data. One potential reason for the low learning may be that the data were collected at the end of the semester when student-participants may be less intrinsically motivated and more fatigued as they rush to complete multiple experimental sessions by the end of the semester.

[6] Additionally, no correlations were found with absolute values of the learning and generalization asymmetries. The absolute values indicate the degree of any bias, positive or negative.

Nonetheless, Study One did provide correlational evidence that trait mindfulness is associated with less negativity bias, and it raised questions about a possible positivity bias. Study Two extended this research by testing experimentally if mindfulness causes a reduction in negativity bias. The second study also allowed for the BeanFest paradigm to be administered again, throughout the semester, to assess if mindfulness reduces negativity bias in attitude formation and whether or not it leads to positivity bias.

CHAPTER 3 Study Two

The second study used a between-groups experiment to test for a causal relationship between mindfulness and negativity bias. The goal of the study was to determine whether a mindful state would reduce negativity biases in attitude formation and generalization. Specifically, a laboratory induction of mindfulness was compared to an unfocused attention induction to test for reduced bias in attitude formation and generalization within the BeanFest paradigm. Originally, it was predicted that the mindfulness induction condition would demonstrate less biased learning and, thus, exhibit more equivalence in formation and generalization of positive and negative attitudes as compared to a control condition. However, there was also the potential that participants in the mindfulness condition would demonstrate a positivity bias. In Study One, more mindful participants tended to learn positive stimuli in the BeanFest game better than less mindful participants, and they reported higher levels of optimism on the Future Events Scale. Thus, it was possible that individuals in the mindfulness induction condition would learn positive beans better than negative beans. Cognitive style questionnaires from Study One also were included and the effects of the mindfulness manipulation on these measures was explored.

Method

Participants

As in Study One, undergraduate psychology students participated for extra course credit, and were recruited using the university's online study recruitment system. The

study topic again was advertised as "Personality and Games." Those under 18 years of age and those who had participated in other studies using BeanFest were not eligible to participate.

The target sample size was 150. A power analysis (Cohen, 1992) based on .80 power, an alpha level of .05, and a medium effect size determined a necessary sample size of 128. The target was higher to account for potential exclusions. Due to atypically slow recruitment, the total sample size was 122. Nine exclusions were made: Three were due to technical issues (using the wrong keyboard keys; computer restart), one was confrontational and asked to leave, and the other four did not follow directions and take the study seriously (e.g., using the same response key for every questionnaire item). Thus, the final sample was comprised of 113 participants (51.3% female) with an average age of 19.91 (*SD* = 2.66). Thirty-nine % identified as 'White,' 30% identified as 'Black/African-American,' 18% identified as 'Asian,' 4% identified as 'Hispanic/Latino,' and the remaining 9% identified as 'Other.'

Manipulation

The experimental condition received instructions adapted from those used previously (Arch & Craske, 2006; Segal et al., 2002) to induce an approximation of a mindful state. These instructions tell participants that they are going to practice a process to help them perceive things in a way that is deeply aware of the present instant. Initial instructions encourage participants to assume a comfortable, erect position in their chairs and to gently guide their awareness to the current sensations in their bodies as they sit. The instructions then guide participants to anchor their attention on the qualities of each

breath as it occurs, without trying to control the breath but simply experiencing it as it is in that moment with a sense of curiosity and patience if possible. Additional instructions guide participants to register and accept any thoughts or feelings as they occur – acknowledging them without dwelling on them. If they notice that their mind has wandered, which tends to happen, they are to acknowledge that with a sense of self-congratulation for reconnecting to the present moment. Reminders and variations of these instructions are repeated periodically throughout the 15-minute instructional period.

The control condition received instructions on unfocused attention adapted from Arch and Craske (2006). These instructions tell participants that they are going to practice a process to perceive things in a way that lets their mind wander freely. They are told to simply think about whatever comes to mind, and to let their mind wander freely without trying to focus on anything in particular. Close variants of these instructions are repeated throughout the 15-minute instructional period at the same time intervals used in the mindfulness induction instructions.

Both sets of instructions were pilot tested prior to the start of Study Two, with a state version of the MAAS administered afterward as a manipulation check. The state MAAS (Brown & Ryan, 2003) includes 5 items from the larger trait MAAS measure, slightly rephrased to assess state mindfulness. The items were selected for the state scale based on their applicability to a variety of situations. The state MAAS has shown good predictive and construct validity. It also has demonstrated internal reliability ($\alpha = .92$) when repeated measures were collapsed across time in previous research (Brown & Ryan, 2003), based on its small number of items. This manipulation check was performed

only during pilot testing to avoid exposing the control participants to potential cues to be mindful during the actual experiment. A *t*-test was used to compare the two conditions on the state MAAS and confirmed that the mindfulness induction condition scored higher (M = 3.50, SD = .88) than the control condition (M = 2.50, SD = .48), $t(18) = 3.31$, $p = .004$.

Procedure & Measures

Similar to Study One, participants were greeted by an experimenter and told that they would be participating in a study on personality and games. Again, up to six participants attended a session at one time, seated at individual computer cubicles. After the experimenter obtained informed consent, the participants were randomly assigned to either the experimental (mindfulness) or control condition. All participants in one session were assigned to the same condition to maintain a consistent environment and avoid potential distractions. Both conditions received 15 minutes of pre-recorded instructions that they listened to on individual headphones.

Immediately following the instructional period, all participants completed most of the measures from Study One, again administered via computer using Inquisit and MediaLab. First, the PANAS was used to assess any post-induction differences in mood state between the two conditions and as a potential correlate with the BeanFest measures. Next, participants played the BeanFest game as it was described in Study One. The BeanFest indices served as the primary dependent measures. State anxiety, which could be related to performance in BeanFest and/or an alternate explanation for results, was then measured, followed by measures of cognitive style. The cognitive style measures

served as secondary dependent variables, given that the duration of the induced mindful state was unknown. State anxiety was assessed using the state subscale of the STAI. The measures of cognitive style included the DAS, LMSQ, and FES. Participants completed a measure of trait mindfulness, the MAAS, and the same demographic questions used in Study One, so that any differences between groups on these measures could be statistically controlled for (or further investigated) if warranted. Additionally, four questions were used to assess the extent to which the participant complied with the manipulation and BeanFest instructions. The two questions concerning manipulation compliance were: "To what extent did you follow the instructions during the audio recording at the beginning of this study?" and "How difficult or easy was it to follow the instructions during the audio recording?" which were correlated, $r(111) = .37$, $p < .001$. The two questions for BeanFest compliance were: "To what extent did you follow the instructions during the BeanFest game?" and "To what extent did you try to learn if the beans were helpful or harmful based on their appearance (their shape and/or speckles)?" which also were correlated, $r(111) = .44$, $p < .001$. Participants indicated their responses using 5-point Likert scales ranging from 1 *(Not at all)* to *5 (Completely),* except for the second manipulation question that ranged from 1 (*Difficult*) to 5 (*Easy*). Composite scores were created for manipulation compliance and BeanFest compliance by summing the scores for the two questions that pertained to each form of compliance. Trait measures of depression or anxiety were not expected to be affected by the brief induction. Hence, these trait measures were excluded. After completing the study procedures, participants were fully debriefed, thanked and dismissed.

Results

Preliminary Analyses

Initial inspections of the data revealed five outliers: two for the NA subscale of the PANAS, one for the LMSQ, and two for the Optimism subscale of the FES. Comparisons of the 5% trimmed mean to the overall mean for each of these variables determined that these values significantly affected the mean, so they were excluded. After excluding these values, the distributions for all variables were acceptably normal.

Descriptive Statistics

Descriptive statistics, including means, standard deviations and ranges, for all variables of interest can be found in Table 4. Measures of central tendency and variability for the affective, cognitive style, and mindfulness measures for the full sample again were consistent with previous findings.

For the BeanFest data for the full sample, the mean phi coefficient (indicating learning) was .21 (*SD* =.29), which was significantly different from zero, $t(112) = 7.96$, $p < .001$, indicating that overall the participants did learn and perhaps slightly better than in Study One. The overall percent of positive beans correct (*M* =.61, *SD* =.17) and percent of negative beans correct (*M* =.60, *SD* =.20) both were significantly greater than chance (50 percent), $t(112) = 6.59$, $p < .001$ for percent positive correct and $t(112) = 5.34$, $p < .001$ for percent negative correct. The learning asymmetry (the difference between percents positive and negative correct) was -.01 (*SD* = .24), which a *t*-test showed to be equivalent to a zero difference, $t(112) = -.39$, $p = .697$. The mean generalization

asymmetry of .06 (*SD* = .29) was significantly different from zero, $t(112) = 2.18$, $p = .031$, indicating an overall negativity bias in generalization.

Table 4

Means, standard deviations, and ranges for all variables of interest (Study 2)

Variable	Mean	SD	Range
BeanFest indices			
Learning	.21	.29	1.24
Percent positive correct	.61	.17	.83
Percent negative correct	.60	.20	.78
Learning asymmetry	-.01	.24	1.53
Generalization asymmetry	.06	.29	1.87
Cognitive style measures			
DAS	118.58	28.77	162
LMSQ	55.93	9.01	45
FES – Optimism subscale	27.76	16.06	80.00
FES – Pessimism subscale	-1.21	17.75	95.00
Affect measures			
PANAS – positive affect subscale	28.24	7.95	40.00
PANAS – negative affect subscale	15.14	5.41	26.00
STAI – state subscale	40.31	11.66	56
Mindfulness measures			
MAAS	3.51	.76	4.00

Tests of Confounds

T-tests were used to examine if the conditions differed on trait mindfulness and state affect. This was important to rule out these variables as potential alternate explanations. The conditions did not differ on trait mindfulness, $t(111) = .019$, $p = .985$. The conditions also did not differ on state affect as measured by the PANAS [for PA, $t(111) = -1.44$, p = .152; for NA, $t(111) = 1.01$, $p = .317$] and the STAI (state subscale

only) [$t(111) = 1.30$, $p = .196$]. The groups also did not differ on any demographic variables (ps > .30).

Tests of Covariates

Zero-order correlations were computed to examine if BeanFest compliance and state affect were related to learning and generalization in BeanFest, the dependent measures in the tests of the primary hypothesis. Unsurprisingly, BeanFest compliance was significantly correlated with learning, $r(111) = .32$, $p < .001$, percent negative correct, $r(111) = .41$, $p < .001$, and generalization asymmetry, $r(111) = .37$, $p < .001$. Learning also correlated with state affect; specifically, there was a positive correlation with the PA subscale of the PANAS, $r(111) = .23$, $p = .013$, and an inverse correlation with the STAI, $r(111) = -.29$, $p = .002$. The generalization asymmetry also inversely correlated with the STAI, $r(111) = -.22$, $p = .021$. Based on these correlations, BeanFest compliance and state affect (positive affect and state anxiety) were controlled for in tests of the primary hypothesis.[7] Manipulation compliance also was controlled for based on the theoretical justification that greater compliance should produce greater effects, and vice-versa.

In the tests of the secondary hypotheses in which the cognitive style measures served as dependent variables, the analyses controlled for manipulation compliance and state affect (as measured by the NA subscale of the PANAS and the STAI) because these variables were correlated with the dependent variables (see Table 5 for the correlations).

[7] PANAS scores were not controlled for when testing for effects on generalization asymmetry because no correlations were found between these measures.

Table 5

Correlations between manipulation compliance, affect, and cognitive style measures (Study 2)

	1	2	3	4	5	6	7
1. Manipulation compliance	--	--	--	--	--	--	--
2. PANAS – positive affect subscale	.20*	--	--	--	--	--	--
3. PANAS – negative affect subscale	-.16†	.03	--	--	--	--	--
4. STAI	-.21*	-.38**	.51**	--	--	--	--
5. DAS	-.26**	-.08	.40**	.40**	--	--	--
6. LMSQ	-.17†	-.07	.21*	.32**	.34**	--	--
7. FES – pessimism subscale	-.24*	-.13	.30**	.36**	.44**	.18†	--
8. FES – optimism subscale	.26**	.24*	-.09	-.34**	-.23*	-.23*	-.26**

† $p < .10$, * $p < .05$, ** $p < .01$

Tests of Primary Hypothesis

A 2 (mindfulness or control condition) x 2 (positive or negative bean valence) factorial ANCOVA was used to analyze the effect of condition and bean valence on percent learned correctly, while controlling for both composite measures of instructional compliance (manipulation and BeanFest) as well as state affect (PA and STAI) to ensure that effects of these variables were minimized.[8] There was no main effect of condition,

[8] Assumption testing for the ANCOVAs confirmed homogeneity of the regression slopes for the covariates, meaning that they did not interact significantly with the independent variables in their relationships to the dependent variable. The covariates also did not demonstrate multicollinearity with each other.

$F(1, 107) = .85$, $p = .360$. Participants in the mindfulness condition did not correctly identify more beans than the participants in the control condition. There also was not a main effect of valence, Wilks Lambda = .99, F (1, 107) = .06, $p = .814$. As previously reported, there was not an overall learning asymmetry. However, as hypothesized, there was a significant interaction between condition and valence on the percent correct, Wilks Lambda = .963, $F(1, 107) = 4.07$, $p = .046$, partial eta squared = .037. The interaction is depicted in Figure 3. The adjusted mean learning asymmetry in the control condition was .04 (negatively biased) and in the mindfulness condition it was -.06 (positively biased). To investigate this interaction further, one-way ANCOVAs were run comparing the conditions on percent positive correct and percent negative correct. The conditions significantly differed on percent negative correct, $F(1, 107) = 4.17$, $p = .044$. The adjusted means revealed that the mindfulness condition ($M = .56$, $SE = .02$) developed fewer negative attitudes than the control condition ($M = .64$, $SE = .02$). No significant differences between the conditions were found for percent positive correct, $F(1, 107) = .42$, $p = .517$.

A one-way ANCOVA was then used to test if the generalization asymmetry differed by condition, controlling for instructional compliance and state anxiety as well as learning (to assess bias beyond that accounted for by learning). The difference between the conditions was marginally significant, $F(1, 107) = 3.30$, $p = .072$. The control condition (adjusted $M = .11$, $SE = .04$) demonstrated more negativity bias in generalization than the mindfulness condition (adjusted $M = .01$, $SE = .04$). The mean

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Additionally, homogeneity of variances was tested using Levene's test and homogeneity of

generalization asymmetry in the control condition differed significantly from zero [$t(56) = 2.68$, $p = .010$], whereas the generalization asymmetry in the mindfulness condition was essentially the same as a zero difference [$t(55) = .56$, $p = .581$].

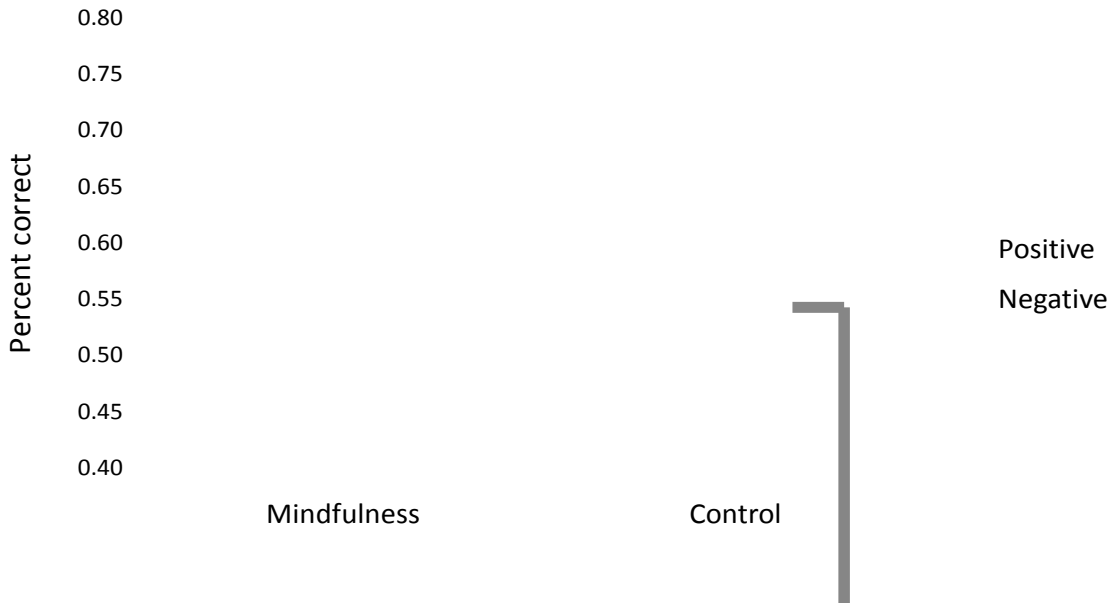

Figure 3. Interaction between condition and valence on percent correct in BeanFest (Study 2)

Tests of Secondary Hypothesis

One-way ANCOVAs were used to examine if the cognitive style measures differed by condition, controlling for effects of manipulation compliance and state affect (state anxiety and negative affect for the DAS, LMSQ, FES Pessimism; state anxiety and positive affect for the FES Optimism). The conditions did not significantly differ on the DAS [$F(1, 106) = .18$, $p = .675$], the LMSQ [$F(1, 105) = .55$, $p = .461$], or the Pessimism subscale of the FES [$F(1, 106) = .03$, $p = .854$]. However, the conditions did differ significantly on the Optimism subscale of the FES, $F(1, 106) = 6.07$, $p = .015$. The

intercorrelations was tested using Box's M; neither test was significant.

mindfulness condition (adjusted M = 31.44; SD = 2.04) demonstrated greater optimism than the control condition (adjusted M = 24.14, SD = 2.02).

Correlations

Correlations between trait mindfulness and the negative cognitive style measures were determined to examine if they replicated those found in Study One. Similar, albeit somewhat stronger, inverse relationships to those in Study One were found between the MAAS and the DAS, LMSQ, and the Pessimism subscale of the FES (rs = -.44, -.36, -.36, respectively; all ps < .001).

Discussion

The aim of Study Two was to test for a causal relationship between mindfulness and reduced negativity bias. The primary hypothesis was that a mindfulness induction, compared to a control condition, would result in less negativity bias in attitude formation and generalization as measured in BeanFest. This was supported by the results. However, it was originally hypothesized that mindfulness would reduce bias overall, which would produce more equal learning and generalization of positive and negative valences rather than reversing to a positivity bias. Yet, the results of Study One raised the possibility that mindfulness might produce a positivity bias. For learning, or attitude formation, in Study Two a positivity bias was indeed found: The mindfulness condition formed more positive attitudes relative to negative attitudes as compared to the control condition. Inconsistent with Study One findings, the positivity bias for more mindful participants was due to decreased learning of negative game beans, not increased learning of positive game beans. A potential explanation for this apparent inconsistency is that the

mindfulness induction might have been taxing for novices and thus dampened their learning of positive and negatives. That is, perhaps learning benefits from the mindfulness induction were offset by the effort of the induction. Overall level of learning did not differ between conditions in Study Two, but in Study One learning – and specifically positive learning – increased with mindfulness. If the participants in the mindfulness condition had been less taxed, perhaps positive attitude formation would have been more pronounced and account more for the positivity bias. This or other differences between trait mindfulness and the brief induction could account for the results in the two studies.

In any case, for attitude generalization, the results trended toward indicating that neither a positivity nor negativity bias was evident for the mindfulness condition, whereas a negativity bias was evident for the control condition. These results seem to suggest that when an object was associated with a definite valence, mindfulness increased attention to and learning of positives over negatives. However, when an object was not definitely associated with a valence, mindfulness decreased bias and led to a more egalitarian approach of categorizing novel targets.

A tentative, secondary hypothesis was that the mindfulness induction would produce less negativity bias on measures of cognitive style when compared to the control condition. For all measures of negative cognitive style, there were no differences between the conditions. It was proposed earlier that the duration of the mindfulness induction's effects might have been too short to affect these measures. Yet, the mindfulness condition showed higher levels of optimism than the control condition. It is

unlikely that the two conditions differed on optimism prior to the induction because they did not differ on any other measure of cognitive style or affect with which optimism correlates. It is possible that the brief mindfulness induction affected only the measure of positivity and not the self-report measures of negativity. Perhaps changes on these measures of negative cognitive style require more training or time to emerge. Trait mindfulness correlated inversely with the measures of negative cognitive style, as in Study One, but based on this research it is uncertain whether mindfulness would cause changes in these measures of negative cognitive style.

One might wonder why the mindfulness condition reported a more positive outlook on the optimism measure but did not generalize positive attitudes in BeanFest. Perhaps although the concept of optimism involves generalized positive expectancies, the specific scale used here is more similar to the attitude formation task because it involves potential scenarios with pre-defined valences that participants have learned from prior experience. That is, they are asked to rate the likelihood that they will experience various events which are clearly positive in valence. Thus, this scale seems to measure emphasis placed on known positives, which is more similar to the attitude formation task than the attitude generalization task. The latter differs in that the stimuli to be categorized are novel, albeit similar in appearance to previous stimuli, and participants do not receive any indication of their valence. If the optimism scale is more similar to the attitude formation task, then this reinforces the idea that being more mindful caused participants to give more weight to known positives over known negatives but not to extend this bias to

unknown stimuli. This indicates that mindfulness may reduce generalization of the valence of a known target to a similar but novel target.

Because the conditions did not differ on measures of state affect and the analyses controlled for those measures based on their relationships with the dependent variables, neither affective valence nor arousal can account for the above findings. The results are also compelling considering that the study's power was limited by not reaching the target sample size. Controlling for instructional compliance helped to increase power by reducing error variance related to motivational issues and other reasons for reduced compliance which may have plagued Study One.

CHAPTER 4 General Discussion

The current research proposed and tested the general hypothesis that mindfulness reduces bias, specifically negativity bias, and that this may at least partially explain why mindfulness reduces or prevents emotional distress.

The goal of Study One was to establish correlational evidence to support the proposed association between trait mindfulness and reduced negativity bias in attitude formation and generalization as well as on measures of negative cognitive style. Additionally, the proposed mediational role of these reduced negativity biases in the inverse relationship between trait mindfulness and predisposition to depression and anxiety was tested. Trait mindfulness was associated with better learning of stimuli during the BeanFest game and, more specifically, forming a greater number of positive attitudes. Trait mindfulness also was inversely related to measures of negatively biased attitudes and attributions, indicating that those who were more mindful reported less negatively biased cognitions. Further, this lower negativity bias partially accounted for the inverse relationship between trait mindfulness and emotional distress (as indicated by depression and anxiety inventories). Thus, the findings from Study One supported the initial contentions that those who are more mindful are less negatively biased in their cognitive content, and that this contributes to their lower levels of emotional distress. However, the unexpected association between mindfulness and positive attitude formation and trait optimism raised the possibility that mindfulness was associated with less negativity bias not because of a relative lack of bias (i.e., equivalence in attention to

and appreciation of positive and negative information) but because of a bias in the opposite direction – toward positivity.

Study Two built on these findings using a randomized, controlled experimental design to test for causality. Participants completed either a mindfulness induction or a control exercise, and then they completed measures of attitude formation and generalization followed by measures of negative cognitive style. Overall learning did not differ by condition, meaning that participants learned essentially the same number of stimuli. However, participants in the mindfulness condition formed more positive attitudes than negative attitudes whereas the reverse was true for participants in the control condition. Given that a full feedback version of the BeanFest game was utilized, participants in the two conditions seemed to weight the positive and negative information differently. Those in the mindfulness condition also reported significantly more optimism than those in the control condition; that is, they perceived a higher likelihood that they would experience various positive events in the future. These findings suggest that mindfulness caused participants to be biased toward positivity, rather than less biased as initially proposed. However, this apparent positivity bias may only apply to stimuli with a defined valence, considering that a marginally significant trend indicated that participants in the mindfulness condition did not demonstrate bias, either positive or negative, when generalizing attitudes to novel, ambiguous stimuli (whereas the control condition demonstrated a negativity bias). Together, these findings provide initial evidence suggesting that mindfulness may create a bias toward recognizably positive stimuli without producing bias when encountering unknown stimuli.

It should be noted that in Study Two, the mindfulness induction did not affect scores on the measures of negative cognitive style. However, in both studies trait mindfulness was inversely associated with these measures. With correlational findings, there is the potential for bi-directional relationships and effects from third variables. Thus, the precise nature of the association between the variables is not truly known. Still, the mindfulness induction did reduce negativity bias in both attitude formation and generalization, which supports the possibility that mindfulness does reduce negativity bias. Potentially, the brief induction of mindfulness was not strong or long enough to affect the measures of pre-existing negative cognitions, which were administered at the end of the sessions. Indeed, Ramel and colleagues (2004) found that an eight-week mindfulness training did lead to improvements in dysfunctional attitudes. This provides some evidence that mindfulness can affect pre-existing negative cognitions with longer training. Perhaps similar positive cognitions can be affected more easily by a brief mindfulness training, and this could explain why scores on the measure of optimism were affected by the induction. It is conceivable that mindfulness primarily affects weighting of positive information and that this leads to changes in negative cognitions over time.

The present findings cannot be explained by state affect, including calmness or positive affect. State affect was controlled for in the various analyses, and the mindfulness manipulation in Study Two did not result in differences in affect as measured by the PANAS or STAI between the two conditions (mindfulness versus control). Moreover, participants in Study Two were randomly assigned to conditions, so individual differences such as trait mindfulness and demographics were distributed

evenly between the groups. Given that the manipulation and measures were administered using pre-recorded instructions and through a computer program, respectively, any unintentional experimenter demand effects were minimized.

Connections with Previous Research

The findings from this research concur with and build on previous studies related to mindfulness and bias. As far as negativity bias, the inverse relationship between trait mindfulness and dysfunctional attitudes is in accord with Ramel and colleagues' (2004) finding that a mindfulness-based intervention (MBSR) reduced dysfunctional attitudes. The current research added to such findings by demonstrating that trait mindfulness also was inversely related to pessimism and the looming maladaptive cognitive style, and that a brief mindfulness induction reduced the formation and generalization of negative attitudes. The consistency of the findings across the present two studies and with previous research supports the contention that mindfulness can reduce negativity bias. Importantly, this is also the first study to test and find that less negatively biased cognition partially mediates the inverse relationship between mindfulness and emotional distress.

An intriguing new finding of the current research was a causal link between mindfulness and positivity bias. Previous correlational research has linked trait mindfulness with higher levels of optimism (e.g., Brown & Ryan, 2003). The current studies replicated this finding, and extended such research by showing that a brief mindfulness induction caused an increase in optimism. Of more interest and significance are the relations found between mindfulness and the BeanFest indices. The positivity

biases found with BeanFest are most striking because the attitude formation measure has not been used previously with mindfulness measures or inductions. Also, the advantage of this specific measure is that it provides a clean, objective standard of the valence of stimuli. That is, stimuli have a set positive, negative, or unspecified valence to which participants' responses are compared. There is no interpretation or subjective assessment as to the extremity or valence of the stimuli. Thus, the positivity bias in the mindfulness conditions means indicates a true ratio of how positives were weighted compared to negatives.

Why a Positivity Bias?

Originally, it was proposed that mindfulness would reduce bias overall rather than promote a bias toward positivity. However, in both studies, mindfulness was related to a bias toward learning positive valences. This raises questions about why mindfulness might increase positivity bias, particularly after a brief induction of mindfulness. That is, it was not a choice or change that developed over time. Although a relatively small number of studies exist on the effects of mindfulness-like inductions, they may be most informative to the present research. The induction used here was similar to that used by Arch and Craske (2006), who found that participants who completed the induction reported less negative emotion in response to negatively valenced pictures as compared to control conditions. They also were more willing to view aversive pictures. These findings were interpreted as evidence of reduced emotional reactivity or faster recovery. Similar conclusions have been drawn from other, related induction studies (e.g. Eifert & Heffner, 2003; Levitt et al., 2004), as mentioned previously. It was argued here

previously that the emotional reactivity explanation is somewhat questionable because mindfulness-related inductions also have been found to maintain or even increase sensitivity to the valence of experiences in the moment (e.g., Cioffi & Holloway, 1993; LeBel & Dubé, 2001). However, another possible explanation is faster recovery. All of the induction studies mentioned here that used negative stimuli showed evidence of increased acceptance and faster recovery. It is possible that mindfulness enables individuals to register and then disengage from negative stimuli faster, reducing the attentional, cognitive, and/or emotional weight that such stimuli would otherwise produce. Indeed, Ortner and colleagues (2007) found that individuals trained in mindfulness disengaged from unpleasant pictures faster than control participants, although their study used a longer mindfulness training. Perhaps this ability frees conscious resources to process positive information.

It is also interesting to consider that mindfulness might increase sensitivity to rewards. LeBel and Dubé (2001) found that a sensory monitoring induction (akin to being mindful of sensations), compared to a distraction condition, increased reported pleasure while eating chocolate. Another study (Kiken & Brown, 2008) similarly found that a sensory monitoring induction, compared to distraction and control conditions, increased reported enjoyment while tasting raisins. The valences in the BeanFest paradigm are related to reward (gaining points) or punishment (losing points), and learning to associate the stimuli with the correct consequence. If mindfulness increases sensitivity to the rewarding nature of positive stimuli, while enabling disengagement from aversive stimuli, then perhaps this explains why the mindfulness induction caused

participants to learn the valence of positive beans better. In other words, gaining points was more enjoyable than losing points and the mindfulness induction may have enabled participants to distribute cognitive resources accordingly.

Yet, the extent of the positivity bias produced by mindfulness in this research appeared to be limited to those stimuli with a clearly defined valence. For categorizations of novel, ambiguous stimuli, the mindfulness induction trended toward reducing negativity bias without reversing to a positivity bias. Mindfulness seemed to reduce bias overall. Given that the participants received no information about the valence of these stimuli, indicating an equal likelihood of positive or negative valence (as the mindfulness condition tended to do) was a more accurate response. That said, the unknown stimuli were similar in appearance to the clearly valenced stimuli to which participants were previously exposed. It is remarkable that the mindfulness condition essentially distinguished the new, ambiguous stimuli from the valenced stimuli that they had just learned beforehand, particularly given that they categorized 100 total beans. This supports the idea that mindfulness is more attuned to present experiences and that it can produce less bias when the potential valence of a stimulus is unclear. Brown and colleagues (2007) contend that "When mindful … thoughts are less likely to be colored by beliefs, prejudices and other biases that are not supported by objective or experiential evidence" (p. 213). Accordingly, a lack of evidence of a valence associated with a stimulus should reduce bias in thoughts about that stimulus when individuals are being more mindful. That is what appears to have been found here in terms of positive and negative evaluations. Another way to phrase this is that mindfulness appeared to reduce

overgeneralization of both positive and negative attitudes. This is important to consider, as many biases including those in emotional disorders involve generalizing negativity from something that is actually negative to something similar that is not necessarily negative (e.g., Alloy et al., 2000; 2006).

Likewise, the present findings, although preliminary, have implications for multiple aspects of emotional distress and disorder. First, a reason that mindfulness reduces rumination (Ramel et al., 2004; Jain et al., 2007) could be that negativity is not generalized beyond the actual source. Further, less weight may be given to clearly negative experiences and more weight may be given to clearly positive experiences. With both of these processes, there might be less to ruminate about. This exemplifies how mindfulness may affect thought content by altering the mental context. Receptive, present-moment attention may reduce generalization, which may be aided by or a result of the reduced elaboration on thoughts and feelings described by Segal and colleagues (2002). They also suggested that reduced elaboration could help shift cognitive resources away from known negatives, accepting them and letting them go, to known positives, which could be accepted and appreciated more. For those who increase their exposure to or level of mindfulness over time, pre-existing negatively biased cognitions might be reduced as the study by Ramel and colleagues (2004) found for dysfunctional attitudes. When negative cognitions do arise, they may be recovered from more easily, receiving less emphasis and generalizing less.

This aligns with explanations of how mindfulness-based interventions such as MBCT may prevent the recurrence of depression and reduce anxiety, as well as with

traditional cognitive theories of these disorders. Recall that the aims of mindfulness-based interventions relate to cognitive context whereas the aims of CT involve cognitive content, despite the potential that both approaches could conceivably affect context and content. It was proposed earlier, based on schema modification models described by Hollon and colleagues (1993), that the process of each approach may differ. Mindfulness-based interventions may deactivate negatively biased schemas (by reducing elaboration) and reinforce compensatory schemas (receptively attending to present events and experiences). CT may engage and directly change negatively biased schemas so that they accommodate other perspectives and beliefs. This may be a more active cognitive process that involves evaluating thoughts and therefore more cognitive elaboration than mindfulness-based approaches. It was proposed that the context of mindfulness could result in cognitive changes without actively engaging and testing cognitions, because mindfulness itself might entail a less biased approach. The current findings suggest that this could be at least partly true. Mindfulness did change thought content in the current research, for attitude formation and generalization as well as the perceived likelihood of positive events occurring, without any active effort or aim to change thoughts. Thoughts either became more positive than negative, or less biased toward either valence, depending on whether the task involved defined or ambiguous valences. According to CT, such cognitive changes facilitate improvements in depression and anxiety (Garratt et al., 2007). Thus, even though mindfulness-based approaches do not focus on cognitive content, changes in cognitive content may be key to the effectiveness of these approaches. At the same time, they may add to traditional CT by teaching a mental skill

that reduces the need to actively engage in cognitive restructuring. Of course, these are speculations on the implications of the current findings as they relate to existing theory and research on therapeutic interventions, so they require more empirical validation.

Limitations

While many compelling implications and questions arise from the current findings, there are limitations to this research. First, the operationalizations of mindfulness should be considered. The mindfulness induction in Study Two was a 15-minute training with novices. Thus, it may have only approximated a mindful state. A fuller or truer state of mindfulness might have produced different results, which may account for inconsistencies between the two studies (e.g., mindfulness correlating with increased learning of positive game beans in Study One, whereas the mindfulness condition differed in learning of negative game beans in Study Two). Still, it is interesting and powerful that the brief induction with novices had the effects that it did. It also should be noted that Study One relied on two self-report measures of trait mindfulness, and some disagreement does exist over which, if any, of the self-report scales best assess the construct. However, both scales used have been tested for validity and reliability, and the MAAS has been especially well-tested and widely used compared to other mindfulness scales. Further, non-self-report measures of mindfulness have not been definitively established.

Because Study One was cross-sectional, the meditation model was not tested with data that could account for temporal order as would be possible with longitudinal data. Although reduced negativity bias partially accounted for the inverse correlation between

trait mindfulness and emotional distress, it was not demonstrated that mindfulness preceded cognitive changes or that cognitive changes preceded emotional distress outcomes. One might contend that reduced emotional distress accounts for changes in cognition. In Study Two, mindfulness did not produce significant differences in affect and still reduced negativity bias on certain cognitive measures, although it did not reduce negativity bias on the cognitive style measures used in the meditational analyses in Study One. It has been proposed here based on a previous study that longer training may be needed to produce changes on the cognitive style measures. Additionally, previous longitudinal and experimental studies do support that changes in negatively biased cognitions precede improvements in symptoms of depression and anxiety (Alloy et al., 2000, 2006; Garratt et al., 2007). Thus, the mediation model tested in Study One has some justification and provides a testable framework for future research.

Generalizability of the current findings should also be considered. First, the undergraduate samples, although diverse, may not necessarily represent the typical adult population. They were not clinical samples, either, so the results here might not generalize to clinical populations. Additionally, the BeanFest paradigm is a simple, static world whereas real life is complex and dynamic. However, the aim of these studies was to demonstrate that mindfulness could reduce bias, and the BeanFest paradigm provided a clear, objective measure of this. Similarly, generalizability to certain populations was not a main concern of this research because it aimed to provide an initial experimental test of a basic research question, to provide a basis for future studies that can better address generalizability and applied relevance.

However, the Study One sample was of some concern as far as overall levels of motivation or comprehension of some of the BeanFest instructions. Based on the relatively low levels of learning in BeanFest and anecdotal reports from experimenters of low motivation, this may explain the failure to replicate past correlations between the BeanFest measures and the measures of cognitive style and emotional disorders. The undergraduate population at this university may differ from the undergraduate populations used in previous studies with BeanFest, either in terms of their motivation or other factors. Study Two attempted to account for this to some degree by asking participants to report honestly on their compliance with the manipulation and BeanFest. More research is being planned to investigate potential differences in the populations and to increase motivation and instructional clarity.

Future Directions

Future research is needed to replicate the current findings, as they are preliminary despite the various potential explanations and implications posed here. Replications could use other samples and incorporate additional or different measures of negativity and positivity biases. Longitudinal research would be helpful for examining the effects of longer mindfulness training on cognitive biases and to test the temporal order of the variables in the mediation model.

If the positivity bias is replicated in future research, more research should investigate its scope and potential mechanisms behind it (e.g., increased attention to positives versus decreased attention to negatives). As mentioned earlier, fatigue may mask effects of mindfulness inductions in novices, so this could be investigated and

controlled for in future studies. It also could be revealing to test if mindfulness increases learning through positive reinforcement. Further, it could be helpful to measure positivity bias along with recovery or disengagement from negative stimuli, to see if the latter plays a role in the former.

The potential for a lack of bias should continue to be investigated as well. The current research suggests that mindfulness may reduce bias toward novel, ambiguous targets. This should be replicated with multiple forms of stimuli. Research could also investigate if and how mindfulness affects the ability to discriminate between familiar stimuli of a defined valence and similar but new stimuli of an undefined valence.

Conclusion

The present research was a preliminary step in testing for causal links between mindfulness and bias. Mindfulness was found to reduce negativity bias, and this may partially explain why mindfulness reduces emotional distress. Surprisingly, mindfulness also produced a positivity bias on measures of attitude formation and optimism – tasks with clearly valenced stimuli. It also appeared that mindfulness reduced bias overall in generalizing attitudes to ambiguous stimuli. The findings may have important implications for how mindfulness contributes to psychological well-being, as well as how individuals perceive and interpret their broader social worlds.

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VITA

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