2016

The Effects of a Brief Mindfulness Intervention on Negativity Bias for Ambiguous Facial Expressions

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Abstract

This study investigated whether a brief mindfulness intervention influenced dysphoric participants' appraisals of ambiguous facial expressions of emotion. Previous research suggests dysphoric individuals display a negativity bias, or a propensity to view ambiguous information as more negative, which may contribute to the development of clinical depressive disorders. Recent evidence suggests that mindfulness may mitigate this effect; however, the impact of mindfulness on socially relevant appraisals of ambiguous emotional expressions remains unknown. In the present study, 64 participants (36 without dysphoria, 28 with dysphoria) rated the relative emotional valence of six ambiguous facial expressions after listening to either a 19-minute mindfulness recording or a 19-minute excerpt from *The Hobbit* audiobook. The dysphoric participants who received the mindfulness meditation showed a marginally significant tendency to rate the ambiguous facial expressions as more positive than the dysphoric group in the control condition. The results provide tentative support for the hypothesis that a brief mindfulness intervention is capable of reducing dysphoric individuals' negativity bias for ambiguous facial expressions. However, the effects of the brief mindfulness intervention were transient and had largely dissipated by the time participants had completed the study. Thus, brief mindfulness meditation interventions may be of limited practical benefit, although more enduring changes in negativity bias might result from longer term, therapeutic mindfulness interventions. Implications and directions for future research are discussed.

Mindfulness, Dysphoria, and Negative Interpretation Bias in Ambiguous Faces

Does mindfulness influence the negative interpretation biases associated with depression and dysphoria? Although considerable research has investigated both the importance of facial affect processing exacerbating clinical depression (for a review, see Bistricky, Ingram, & Atchley, 2011) as well as the benefits of mindfulness meditation for depressogenic cognition, few studies have investigated how the two phenomena might interact. An examination of the literature regarding cognitive bias in dysphoria, the importance of facial information, and the mechanisms of mindfulness-based meditations will set the stage for this study's exploration of the relationship between dysphoria and mindfulness in ambiguous facial affect appraisal.

Cognitive Bias in Dysphoria

Over the last half-century, cognitive models have emerged as a major force in our understanding of the development, recurrence and maintenance of major depressive disorder (MDD) (Bourke, Douglas, & Porter, 2010). MDD is a condition characterized by a variety of different symptoms, but it is most commonly associated with increased fatigue, changes in sleep or eating habits, suicidal ideation and a sense of hopelessness and worthlessness (Belmaker & Agam, 2008). Cognition-based theories of depression suggest distorted thoughts and perceptions are also hallmarks of depressive disorders (Beck, 1987). Negative interpretation biases, which are one form of distorted cognition, cause individuals who are depressed to interpret the emotional information in their environments as more negative than non-depressed individuals (Bourke, Douglas, & Porter, 2010). This in turn exacerbates their current depressive state (Hale, 1998) or, if

the individual is dysphoric, contributes to the development of clinical depression (Bistricky, Ingram, & Atchley, 2011).

In a review of 40 studies, Bourke, Douglas and Porter (2010) found that in addition to increased selective attention for negative stimuli, those with MDD also evaluate positive and neutral or ambiguous expressed facial emotion (EFE) as less happy and more negative or sad than healthy controls. As decoding facial emotions is critical to successful social functioning (Corden, Critchley, Skuse, & Dolan, 2006; Fridlund, 1991), impairment in an individual's ability to accurately recognize EFE has been linked to impairments in social functioning (Hooker & Park, 2002). Furthermore, in a sample of clinically depressed outpatients, Hale (1998) found that the degree of impairment in appraising emotional facial affect reliably predicted both depression duration and the severity of depressive episodes.

Although the effects of negative interpretation have been well established in the clinical depression literature, studies have demonstrated that these biases are not exclusive to those with MDD; similar negative biases also exist for those with dysphoria, or sub-clinical levels of depression (Cowden Hindash & Amir, 2012; Beevers, Wells, Ellis, & Fischer, 2009). Dysphoric individuals have been found to form word associations between negative words and ambiguous sentences more rapidly than a non-dysphoric control group (Cowden Hindash & Amir, 2012). Furthermore, Beevers et al. (2009) found that when evaluating neutral or ambiguous faces (where ambiguous facial expressions consisted of a 50% morph of happy and sad prototypical faces), dysphoric individuals appraised such faces considerably more negatively than a non-dysphoric control group. Importantly, Beevers et al. (2009) found no difference between dysphoric

and non-dysphoric samples in the accuracy of recognizing the emotional content of prototypical EFEs (i.e. 100% happy, 100% sad, 100% angry, etc.). These results are consistent with research suggesting that MDD samples' negative interpretation bias influences their appraisal of neutral or ambiguous faces but not prototypical EFE (Bistricky, Ingram, & Atchley, 2011; Gollan, Pane, McCloskey, & Coccaro, 2008). Oliveira and colleagues corroborate these findings by demonstrating different patterns in neural activation in depressed patients only when viewing neutral faces (Oliveira, Ladouceur, Phillips, Brammer & Mourao-Miranda, 2013).

Social Success Requires Accurate Facial Affect Appraisal

Research on facial affect has demonstrated that EFEs play a critical role in human interaction (Horstmann, 2003). More specifically, facial expressions have been proposed as a way in which humans convey their emotional states, desires and intentions (Horstmann, 2003). Accurately interpreting this face-derived social information is essential to successful navigation of social interactions and thus promotes social cohesion and acceptance (Hareli & Hess, 2012). However, research has suggested that most of the facial emotions individuals encounter in their day-to-day interactions are ambiguous (Hassin, Aviezer, & Bentin, 2003). Despite the increased difficulty in distilling emotional information from ambiguous expressions, humans readily derive inferences about emotional states even from the minutest aspects of facial expressions (Adams, Nelson, Soto, Hess, & Kleck, 2012). As a result, even though most facial expressions may convey little obvious emotion, humans are nonetheless able to extract a wealth of emotional information.

Given the considerable research demonstrating the value of social and interpersonal information conveyed by human facial expressions, any deficits or biases in the processing of facial affect information are linked to significant impairments in social functioning. More specifically, difficulties in affect recognition are implicated in social dysfunction that can accompany dysphoria and depression (Hooker & Park, 2002) and may therefore be a critical component in the emergence and propagation of depression (Beck, 1987, Bistricky, Ingram, & Atchley, 2011). Furthermore, biases in facial affect appraisal are associated with not only longer duration and severity of depressive episodes but also a greater likelihood of relapse (Hale, 1998). Thus, considerable efforts have been made to develop therapies that address depressed or dysphoric individuals' biased interpretation of EFE in their surroundings (Cowden Hindash & Amir, 2012).

Mindfulness

The study of mindfulness, defined as a non-judgmental, receptive awareness and acceptance of events and experiences as they occur (Brown & Ryan, 2003), has garnered considerable interest from both the scientific community and the general public in recent years. Over the past decade, meditations and therapies rooted in mindfulness have been developed for both their therapeutic potential but also as a means of achieving greater overall well-being (Brown & Ryan, 2003). As a result of this interest and the promising therapeutic potential of mindfulness-based therapies (Kuyken et al., 2010), a substantial body of research has evaluated how mindfulness may improve well-being and reduce the experience of anxiety, stress, and depression. Such interventions aim to therapeutically cultivate mindfulness so as to increase the frequency with which individuals experience mindful states in daily life. Trait mindfulness reflects an individual's dispositional level

of mindfulness or how frequently individuals experience states of mindful awareness (Frewen et al., 2008; Waszczuk, Zavos, Antonova, Haworth, Plomin, & Eley, 2015). Thus, an individual's initial degree of trait mindfulness can be further cultivated through clinical interventions to increase the frequency with which an individual experiences states of mindfulness in daily life.

In a series of five studies, Brown and Ryan (2003) found that trait mindfulness was associated with many common correlates of well-being. More specifically, trait mindfulness was inversely associated with common measures of depression (CES-D, BDI) and anxiety (STAI, POMS) and was positively associated with positive affect and emotional awareness (Brown & Ryan, 2003). Similarly, in non-clinical samples, high levels of trait mindfulness have been associated with less ruminative brooding and, as a result, decreased depressive symptomology (Alleva, Roelefs, Voncken, Meevissen & Alberts, 2014). Interventions designed to cultivate trait mindfulness in non-clinical samples have shown reductions in dysfunctional attitudes and negative automatic thought patterns and have helped to mitigate the impact of stressful events on emotional well-being (Kaviani, Javaheri & Hatami, 2011).

Mindfulness and Depression

The benefits of mindfulness observed in non-clinical samples have also emerged in clinical populations, prompting the development of a number of psychotherapeutic interventions that feature a prominent mindfulness component. Such interventions have been shown to substantially reduce relapse rates of formerly depressed individuals (Raes, Dewulf, Van Heeringen & Williams, 2009; Teasdale, Segal, Williams, Ridgeway, Soulsby, & Lau, 2000) and appear to be as efficacious as medication (Teasdale et al.,

2000). Furthermore, the cultivation of mindfulness has been associated with reductions in negative cognitions (Frewen, Evans, Maraj, Dozois, & Partridge, 2007; Gilbert & Christopher, 2010; Kiken & Shook, 2014), habitual mental processes (Bishop et al., 2004), rumination (Paul et al., 2013; Ramel, Goldin, Carmona, & McQuaid, 2004; Williams, 2008), maladaptive self-guides (Williams, 2008), and general depressive symptomology (Teasdale, Segal, Williams, Ridgeway, Soulsby, & Lau, 2000). Clearly, mindfulness interacts with a myriad of different components of depression, but recent studies of mindfulness-based therapies have focused primarily on two broad hallmarks of depression: maladaptive cognitive processes (Beck, 1987) and depressed mood (Gilbert & Christopher, 2010).

Mindfulness and Cognition

As mindfulness is a construct fundamentally rooted in acceptance and focusing on present moment experiences, feelings and thoughts, it is unsurprising that this construct interacts with many of the cognitive components of depression and dysphoria. Such cognitive dimensions include automaticity, rumination, negative self-evaluation, and hopeless worry (Brown & Ryan, 2003; Kang, Gruber, & Gray, 2013; Williams, 2008). Kang and colleagues (2013) have proposed a model wherein mindfulness's cultivation of awareness, attention, focus on the present moment, and acceptance contribute to a general de-automatizing effect. According to their model, these four facets of mindfulness act by discontinuing automatic interference, enhancing cognitive control, facilitating meta-cognitive insight, and hindering thought suppression and distortion (Kang, Gruber, & Gray, 2013). Similarly, Williams (2008) suggested that mindfulness, as a trait that can be cultivated through practice, enables individuals both to recognize when maladaptive

cognitive processes (e.g., cognitive reactivity, biased attention) are active and also to enable individuals to disengage from such detrimental cognitions.

Considerable correlational and experimental evidence suggests mindfulness interacts with many of the cognitive processes associated with depression, but one cognitive process, rumination, is of particular interest in the present study. Given that negative biases have been associated with ruminative cognitive processes (Paul et al., 2013), any reduction in ruminative cognitions may theoretically contribute to a decrease in a depressed individual's negativity bias. Several correlational and experimental studies of trait mindfulness have found evidence that supports an inverse relationship between trait mindfulness and ruminative thinking (Alleva et al., 2014; Kuehner, Huffzinger, & Liebsch, 2009; Paul, Stanton, Greeson, Smoski, & Wang, 2013; Ramel et al., 2004; Williams, 2008). For instance, Ramel and colleagues (2004) found that an 8-week mindfulness training program designed to cultivate mindfulness significantly decreased ruminative thinking after controlling for reductions in negative affect and dysfunctional beliefs. Thus, if negativity biases are directly associated with rumination, the counter-ruminative facets of mindfulness may result in a reduction of any negativity biases an individual might experience. Critically, though they have received comparably less study, brief mindfulness interventions (15 minutes) have been shown to reduce reactivity to repetitive thoughts characteristic of rumination (Feldman, Greeson, & Senville, 2010).

Mindfulness and Mood

Whereas considerable research supports a relationship between trait mindfulness and the cognitive components of depression, the relationship between depressed mood and mindfulness has received comparably less review. Several studies have found that

greater trait mindfulness is associated with more positive affect in both dysphoric and non-dysphoric populations (Brown & Ryan, 2003; Geschwind, Peeters, Drukker, van Os, & Wichers, 2011; Kiken & Shook, 2011, Waters et al., 2009). Similar research has shown that state mindfulness interventions are also associated with a brief increase in positive affect (Brown & Ryan, 2003; Geschwind, Peeters, Drukker, van Os, & Wichers, 2011; Kiken & Shook, 2011). Although positive mood states have not always been observed in mindfulness meditation studies (Kiken & Shook, 2014; Johnsons, Gur, Favid, & Currier, 2015), substantial evidence suggests that such alterations in mood reliably occur. Of note, one recent study found that both single episodes of mindfulness meditation and sham meditation resulted in an increase in positive affect (Johnsons, Gur, David, & Currier, 2015). However, focused breathing instructions, which have been used as a proxy for mindfulness training (Arch & Craske, 2006), were present in both the mindfulness and sham meditation conditions (Johnsons, Gur, David, & Currier, 2015), reducing the utility of the sham meditation as a control condition.

Taken together, the correlational and experimental evidence suggest that mindfulness is often associated with an increase in positive affect. A substantial body of experimental research suggests that mood states, even if they are temporary, can independently influence judgments, attitude formation (Kiken & Shook, 2011; Vuoskoski, & Eerola, 2012), attention (Becker & Leinenger, 2011; Beevers & Carver, 2003) and processing of emotional information (Bouhuys, Bloem, & Groothuis, 1995; Hills, Werno, & Lewis, 2011). Of particular interest is one recent study that found that music-induced mood states can directly induce a bias for expressions of facial emotion (Chen, Yuan, Huang, Chen, & Li, 2008). Chen and colleagues suggest that sensitivity to

negative information can be modulated by the experience of an affective state. Consequently, any alterations in mood resulting from mindfulness meditation could lead to potential reductions in negativity bias.

Current Study

Although mindfulness-based paradigms have demonstrated marked success in reducing many cognitive components of depression and dysphoria (Teasdale, Segal, Williams, Ridgeway, Soulsby, & Lau, 2000), to my knowledge only two studies have examined the specific relationship between mindfulness and negativity bias. Kiken and Shook (2011) found that non-dysphoric participants who experienced a fifteen-minute mindfulness meditation displayed a reduced negativity bias with respect to forming attitudes towards novel stimuli. Participants who received a brief mindfulness intervention reported greater feelings of optimism and positive affect compared to those in the control condition. Furthermore, participants in the mindfulness condition reported more positive judgments of novel stimuli compared to the control group (Kiken & Shook, 2011).

Recent imaging and behavioral research by Paul and colleagues (2013) found that for a sample of healthy males, trait mindfulness was associated with reduced negativity bias in response to images of EFE in a response-inhibition paradigm. In this correlational study, participants who had higher trait mindfulness scores were better at inhibiting their responses to negative facial expressions mixed with neutral facial expressions than participants who had low trait mindfulness scores. The authors suggest their results provide evidence that trait mindfulness may be protective against a negativity bias by

buffering against rumination, or, alternatively, by decreasing automatic emotional responding in the insula (Paul et al., 2013).

Although both of the aforementioned studies provide promising evidence that mindfulness may reduce negativity biases, neither study directly addressed whether mindfulness interventions mitigate negative interpretations of EFE that have been observed in dysphoric states. Specifically, while both Kiken and Shook (2011) and Paul and colleagues (2013) evaluated negativity biases in non-dysphoric samples, no research has examined the effect of mindfulness on negativity biases in a dysphoric sample. As such, the primary goal of the present study is to establish whether mindfulness may reduce the negativity biases associated with dysphoria by examining the effects of a brief mindfulness intervention in both dysphoric and non-dysphoric individuals.

Given the extensive effects of mindfulness on the cognitions and affective states associated with depression and dysphoria, it is a logical extension that mindfulness may also decrease dysphoric individuals' negativity biases. If a brief mindfulness meditation is successful in reducing participants' negativity biases, the literature suggests that the effect could be attributed either to an increase in positive mood (Chen, Yuan, Huang, Chen, & Li, 2008; Kiken & Shook, 2011) or to changes in cognition (Paul et al., 2013; Teasdale et al., 2000). Recent research suggests that brief mindfulness meditations may increase an individual's positive mood and may influence their evaluations of novel stimuli (Chen et al., 2008; Kiken & Shook, 2011). Thus, it is possible that an increase in positive mood may lead individuals to interpret facial expressions as more positive. Furthermore, mindfulness has been shown to reduce emotional reactivity and to disrupt rumination (Paul et al., 2013; Teasdale et al., 2000), both of which have been implicated

in the formation and maintenance of negativity biases (Paul et al., 2013). Thus, mindfulness may successfully reduce a dysphoric individual's negativity bias by altering the cognitive processes implicated in the formation and maintenance of dysfunctional cognitions. Alternatively, mindfulness may result in a brief elevation in positive mood, which may enhance individuals' evaluations of the valence of novel stimuli.

These two possible mechanisms of mindfulness would be supported by two different patterns of results. If the data lend support to the mood-based mechanism of mindfulness, then individuals in the dysphoric mindfulness condition should rate faces more positively than the dysphoric individuals in the non-mindfulness control condition. Additionally, due to their increased positive affect, non-dysphoric individuals in the mindfulness condition should rate faces as more positive than the non-mindfulness, non-dysphoric controls. Alternatively, the data supporting the cognitive mechanism of mindfulness would indicate no difference in negativity bias between the non-dysphoric mindfulness sample and their non-dysphoric controls, along with no changes in mood between the two groups. However, the cognitive model would predict that the dysphoric participants who receive the mindfulness intervention would have considerable reductions in their negativity bias compared to the dysphoric, non-mindful control group.

Pilot Study

Introduction

To evaluate the effect of the mindfulness meditation on negativity bias, I first needed to establish that the mindfulness intervention successfully elicited a mindful state. Therefore, I conducted a pilot study to evaluate the efficacy and duration of a brief mindfulness meditation intervention relative to a mind wandering control.

Method

Participants

Participants were 35 college students (11 (31%) male, 24 (69%) female; M_{age} = 18.91, *SD* = 1.10) attending a small liberal arts college in the Midwest. Participants' races and ethnicities were as follows: 23 (66%) Caucasian, 1 (<1%) African American, 5 Asian (14%), 3 mixed race (9%), and 5 Hispanic or Latino (14%). All participants enrolled in introductory psychology classes received psychology course credit for their participation in the study, while other students volunteered to participate with no compensation. Five participants reported prior experience with the practice of mindfulness meditation while the rest were meditation naïve.

Materials

The Center for Epidemiologic Studies Depression Scale (CES-D) is a widely used 20-item self-report measure for assessing depressive symptomology in the general population (Radloff, 1977). Each of the 20 items is rated on a 4-point Likert scale, ranging from 0 ("Rarely or None of the Time") to 3 ("Most or All of the Time"). To control for considerable week-to-week variability in the typical college student's life, the 1-week reporting period was extended to 1 month. Therefore, participants were asked to report how often over the course of the past month they have experienced each item (e.g. "I had trouble keeping my mind on what I was doing").

When used to assess depressive symptoms in the general population, the CES-D has shown robust internal consistency (coefficient $\alpha = .85$; $\alpha = .93$ in the present study) and reasonable six-month test-retest reliability (r = .54). Furthermore, the CES-D is well

correlated with other scales of depression and has reasonable discriminant validity (Radloff, 1977; see Appendix A).

The trait Mindful Attention Awareness Scale (MAAS; see Appendix B) is intended to assess a receptive state of mind in which the individual simply observes what is taking place; this form of attention is a central component of mindfulness (Brown & Ryan, 2003). The trait MAAS is a 15-item measure in which statements are endorsed using a 6-item Likert scale that ranges from 1 (Almost Always) to 6 (Almost Never). It is among the most commonly used measures of trait mindfulness and has consistently demonstrated robust psychometric properties. Internal consistency levels (Cronbach's α) range from .80 to .90 (Brown & Ryan, 2003; in the present study, $\alpha = .82$). The MAAS has demonstrated high test-retest reliability, with 4 week correlations of $r = .81$, and good discriminant and convergent validity (Brown & Ryan, 2003). Given the established relationship between trait mindfulness and negativity bias (Teasdale, Segal, Williams, Ridgeway, Soulsby, & Lau, 2000), the MAAS was used to control for stable individual differences in mindfulness that were not otherwise accounted for by initial state mindfulness.

The Positive and Negative Affect Schedule (PANAS) is a self-report measure of state affect that was used to assess both baseline and post-intervention affect (Watson, Clark & Tellegen, 1988). The PANAS measure is composed of two ten-item subscales: positive affect (PA) and negative affect (NA). Each of the PANAS adjectives (e.g. enthusiastic, inspired, afraid, upset, etc.) is endorsed using a 5-point Likert scale from 1 (very slightly or not at all) to 5 (extremely), reflecting how participants feel in the current moment. Scores on each subscale are summed, with higher scores on each subscale

corresponding to higher levels of positive or negative affect (see Appendix C). The PANAS is the most commonly used measure of affect, and it has demonstrated good internal reliability coefficients (PA α = .89, NA α = .85; Watson, Clark & Tellegen, 1988). Similarly robust reliability was observed in the present analysis (PA_1, α = .94; NA_1, α = .86; PA_2, α = .93; NA_2, α = .92; PA_3, α = .92; NA_3, α = .91).

The State Mindfulness Scale (SMS; see Appendix C) is designed to evaluate two forms of state mindfulness, the objects of mindful attention (i.e., to 'what' an individual attends, which the authors label "Body") and meta-cognitive state (i.e., how an individual attends, labeled "Mind"). The measure is intended to encompass five facets of a mindful state: "awareness, perceptual sensitivity to stimuli, deliberate attention to the present moment, intimacy or closeness to one's present experience, and curiosity" (Tanay & Bernstein, 2013). The SMS is composed of 21 statements about the participants' experiences over the 15 minutes prior to the survey. The SMS contains a list of statements (e.g., "I was aware of different emotions that arose within me") that participants endorsed using a 5-item Likert scale from 1 (not at all) to 5 (very well). The overall SMS has demonstrated robust internal reliability coefficients, with Cronbach's α ranging from .92 to .97 in four separate samples (SMS_{Mind}: α = .91 to .96; SMS_{Body}: α = .85 to .89; In this study SMS_{Mind1} = .94, SMS_{Mind2} = .94, SMS_{Mind3} = .95; SMS_{Body1} = .83, SMS_{Body2} = .86, and SMS_{Body3} = .88). The α in the first administration of the SMS in the present study was similarly robust and consistent with that reported in the literature (SMS_1, α = .95; SMS_2, α = .94; SMS_3, α = .96). Furthermore, the SMS has been shown to be more sensitive to incremental changes in state mindfulness than the MAAS-S

(Brown & Ryan, 2003), another commonly used measure of state mindfulness (Tanay & Bernstein, 2013).

Mindfulness intervention

The meditation intervention consisted of a 15-minute recording of a Zen-Soto priest who is the director of a Midwestern mindfulness training nonprofit organization who has been studying and practicing mindfulness meditation for over 30 years. In the recording, participants were guided to focus their attention on their breathing and bodily sensations and to accept any thoughts that might arise as they occur and without judgment. Reminders and variations of these instructions were repeated over the course of the 15-minute exercise. Critically, prior research suggests that a 15-minute mindfulness intervention is capable of changing cognitive processes associated with negativity biases, such as rumination (Feldman, Greeson, & Senville, 2010). Furthermore, in a non-dysphoric sample, Kiken and Shook (2011) demonstrated that a 15-minute intervention was sufficient to alter negativity biases for novel stimuli. Thus, a 15-minute meditation is likely sufficient to establish a mindful state accompanied by cognitive changes.

Unfocused attention intervention

The unfocused attention control condition consisting of a 15-minute recording was adapted from the work of Arch and Craske (2006) and was recorded by the same mindfulness practitioner described above. Participants were given headphones and received instructions to “simply think about whatever comes to mind. Let your mind wander freely without trying to focus on anything in particular.” Variations on these

instructions were presented every 30 to 60 seconds for 15 minutes (Arch & Craske, 2006).

Facial Stimuli

Facial stimuli were 20 validated, neutrally valenced faces (10 male, 10 female) taken from the Radboud Face Database (Langer, Dotsch, Bijlstra, Wigboldus, Hawk, & Knippenberg, 2010; see Appendix D for stimuli). When the 20 facial expressions are averaged together, an appraisal rating of 50 corresponds to a perfectly neutral score, such that the facial expressions are perceived as no more positive than negative. Higher scores indicate greater appraisal negativity.

Procedure

Upon arrival, participants completed a consent form and were escorted to a small private testing room containing a desk, chair and computer. Prior to their arrival, an Internet survey administered with the Qualtrics program was loaded on the computer in the testing room. Participants then completed the CES-D, MAAS, PANAS, and the SMS, presented in a fixed order using the Qualtrics program. Participants were then randomly assigned into one of two conditions: a brief mindfulness intervention or an unfocused control intervention (adapted from Arch & Craske, 2006; described above). Participants received headphones and were instructed to engage with the audio recording associated with their condition to the best of their ability.

Participants then completed a post-test SMS and PANAS measure, presented in a random order. Upon completion, participants were told that they would be rating hard-to-detect emotions, or micro-emotions, and were provided with instructions detailing how to rate the emotional faces, along with a warning that each face would be presented for a

total of 5 seconds. A total of 20 images were presented one at a time for five seconds each; after the face disappeared, a slide bar appeared on the screen. Participants used the slide bar to identify how positive or negative the emotion expressed by the face was (anchors were “Clearly More Positive Than Negative” and “Clearly More Negative Than Positive”). Higher scores correspond to more negative appraisals of the facial expressions. To proceed to the next face in the paradigm, participants clicked the “next” button at the bottom of the display. The Qualtrics system randomized the order that faces were presented for each participant. Participants then completed a final SMS and PANAS, which were presented in a random order.

Lastly, participants completed a brief demographic questionnaire (see Appendix E) in which they were asked to provide information about their gender, age, race, ethnicity and prior mindfulness meditation experience (see Appendix F, adapted from Jislin-Goldberg, Tanay, & Bernstein, 2012). Participants then received a debriefing form, which contained information for college counseling services, and were thanked for their participation in the study.

Experimental Design

To test its hypothesis, this study used a mixed design. Dysphoria and mindfulness conditions served as between-subject variables; CES-D scores at or above 18 were considered high dysphoria and those of 15 or less were considered low dysphoria scores. Though individuals scoring above a 15 are considered dysphoric (Radloff, 1977), to improve resolution between the high dysphoria and low dysphoria groups, participants scoring a 16 or 17 were omitted from the primary analysis. Participants’ trait mindfulness scores were included as covariates in the analysis. The dependent variable was the

average of each participant's ratings of the relative negativity of the male and female neutrally valenced facial expressions. The participant's pre-intervention and post-intervention PANAS scores were used as a mediating variable to evaluate whether any change in negativity bias might be attributable to a change in mood or to cognitive changes resulting from the mindfulness intervention.

Results

Of the 35 participants, 18 had scores corresponding to low dysphoria (CES-D scores ≤ 15, $M = 9.3$, $SD = 4.6$) while 16 participants had scores that corresponded to high dysphoria (CES-D scores ≥ 18, $M = 30.4$, $SD = 12.3$). One participant had a CES-D score between the criteria for the low dysphoria and high dysphoria groups and was excluded from subsequent analysis. Although participants were randomly assigned to participate in either the mindfulness or mind wandering (control) conditions, those who were assigned to participate in the mindfulness condition had significantly lower trait mindfulness scores, $t(33) = 2.46$, $p = .02$. Likewise, those in the mindfulness condition reported greater dysphoria ($M = 22.65$, $SD = 11.64$) than those in the control condition ($M = 15.83$, $SD = 11.99$), a difference that approached significance $t(33) = -1.70$, $p = .10$ Furthermore, there was a significant difference in state mindfulness at the outset of the paradigm, such that the mindfulness group ($M = 55.24$, $SD = 4.01$) was significantly less mindful than the control group ($M = 66.78$, $SD = 3.90$), $t(33) = 2.06$, $p = .047$. This result indicates that despite randomization, there were significant differences between groups that received the mindfulness and control interventions at the outset of the study.

To evaluate the effect of the mindfulness manipulation, a repeated measures ANOVA was conducted, comparing the mindfulness scores on the SMS over the course

of the experiment (prior to the manipulation, time 1; following the manipulation, time 2; and after participants rated the 20 ambiguous facial expressions, time 3). The repeated measures ANOVA indicated there was a main effect of time on the SMS that approached significance, $F(3, 33) = 4.09$, $p = .051$. Post-hoc paired *t*-tests indicated that there was a significant increase between the initial baseline test and the post-intervention SMS assessment, $t(34) = 2.33$, $p = .03$. Furthermore, additional post-hoc paired *t*-tests indicated there was a significant decrease in mindfulness following the completion of the experimental session, $t(34) = 5.41$, $p < .001$, ($M_1 = 61.17$, $SD_1 = 17.31$; $M_2 = 72.63$, $SD_2 = 24.55$; $M_3 = 51.66$, $SD_3 = 29.12$; see Figure 1). However, the interaction of the mindfulness intervention and the SMS scores over time was non-significant, indicating that the different conditions did not significantly differ in their mindfulness scores over time, $F(3, 33) = 2.13$, *n.s*. This latter result may be complicated by the significant difference in state mindfulness scores between groups at the outset of the study.

To evaluate whether trait mindfulness may have influenced the SMS results, the above analysis was conducted as a repeated measures ANCOVA, with the MAAS as a covariate. This analysis did not yield a significant main effect of SMS scores over time, $F(2, 31) = 1.72$, *n.s.*, nor was there a significant interaction effect between the mindfulness condition and the state mindfulness scores at the three testing intervals, $F(2, 31) = 1.56$, *n.s.*

Exploratory Analyses:

A 2 (high dysphoria, low dysphoria) × 2 (mindfulness intervention, control intervention) analysis of covariance (ANCOVA) test examined whether negativity ratings of male and female neutral facial expressions differed as a function of dysphoria and

mindfulness condition, controlling for the effects of trait mindfulness. Surprisingly, there was no main effect of dysphoria, $F(3, 33) = 1.44$, *n.s*, nor was there a significant main effect of mindfulness condition, such that participants receiving the mindfulness meditation and the mind wandering control condition did not significantly differ in their appraisals of the neutral facial expressions, $F(3, 33) = .46$, *n.s*. However, there was a marginally significant interaction effect of mindfulness intervention and dysphoria condition on facial emotions, $F(3, 33) = 3.93$, $p = .06$, $\eta^2 = .12$. Post-hoc tests indicated that there was only a significant difference between the low and high dysphoria groups in the mindfulness meditation condition, $t(13.3) = 2.17$, $p = .05$, such that the low dysphoria condition viewed faces as significantly more positive ($M = 48.5$, $SD = 2.9$) than those in the high dysphoria condition ($M = 53.5$, $SD = 6.4$; see Figure 2).

As mindfulness dissipated rapidly over time, additional exploratory analyses were conducted to assess whether a shorter task would be more sensitive to the effects of the mindfulness meditation. Thus, an additional 2 (high dysphoria, low dysphoria) × 2 (mindfulness intervention, control intervention) ANCOVA, controlling for trait mindfulness, evaluated differences in negativity ratings for the first five faces presented to participants (N.B. because the faces were presented in random order, the first five faces were different for each participant). As in the full 20 face analysis, there was no significant main effect of mindfulness intervention, $F(3, 33) = .65$, *n.s.* nor, surprisingly, was there a main effect of dysphoria condition, $F(3, 33) = .03$, *n.s.* Additionally, there was no significant interaction between dysphoria condition and mindfulness intervention, $F(3, 33) = 2.66$, *n.s.*

To evaluate the effects of mindfulness on mood over time, two separate repeated measures ANOVAs were conducted. The first, a 2 (mindfulness, control) x 3 (positive affect time 1, positive affect time 2, positive affect time 3), found a significant main effect of positive affect over time, $F(2, 32) = 9.38$, $p = .001$, $\eta^2 = .37$. Post-hoc analyses using a paired *t*-test indicated there was no significant change between baseline and post-intervention positive affect scores, $t(34) = 1.02$, *n.s.* However, there was a significant decrease in positive affect scores between the post-intervention score and post-facial affect rating score, $t(34) = 3.49$, $p = .001$, ($M_1 = 8.17$, $SD = 1.38$; $M_2 = 8.12$, $SD = 1.37$; $M_3 = 7.01$, $SD = 1.19$).

Additionally, ANOVA analyses indicated a marginally significant interaction effect of mindfulness condition on positive affect (PA), $F(2, 32) = 2.93$, $p = .07$, $\eta^2 = .16$. Post-hoc paired *t*-tests found no significant difference in PA between initial and post-intervention PA in the mindfulness condition, $t_{1,2}(16) = .75$, *n.s.* However, there was a significant decrease in PA between post-mindfulness intervention ($M = 21.76$, $SD = 8.33$) and the post-facial affect rating in this condition ($M = 19.29$, $SD = 6.39$), $t_{2,3}(16) = 2.12$, $p = .05$). In contrast, in the mind wandering control condition there were significant decreases between initial PA (time 1; $M = 26.61$, $SD = 8.58$), post-control intervention PA scores (time 2; $M = 23.61$, $SD = 8.05$), and post-affect rating PA scores (time 3; $M = 21.11$, $SD = 7.63$), $t_{1,2}(17) = 2.64$, $p = .02$; $t_{2,3}(17) = 2.86$, $p = .01$.

The second analysis, a 2 (mindfulness, control) x 3 (negative affect time 1, negative affect time 2, negative affect time 3) repeated measures ANOVA, found a significant main effect of negative affect (NA) over time, $F(2, 32) = 12.92$, $p < .001$, $\eta^2 = .45$. Specifically, post-hoc paired *t*-tests indicated that there was a significant decrease in

NA between initial (M = 15.37, SD = 5.36) and post-intervention scores (M = 13.26, SD = 5.49), $t(34) = 2.58$, $p = .01$. Additionally, there was no significant change in NA between the post-intervention and post-facial affect ratings (M = 12.5, SD = 4.28) administrations of the PANAS, $t(34) = 1.32$, *n.s.* There was no significant interaction effect between intervention condition (mindfulness or mind wandering control) and NA, $F(2, 32) = 1.74$, *n.s.*

Discussion

The results from the pilot data first and foremost suggest that the mindfulness intervention and the mind wandering control condition did not elicit the desired increase in mindfulness following the administration of the audio interventions. However, this lack of effect may be due, in part, to the significant difference in dysphoria and trait mindfulness between the mindfulness and control groups at the outset of the study. Because of these differences and the poor statistical power of this pilot study, little can be drawn from the exploratory analyses of the facial affect scores. However, the non-significant difference in mindfulness scores between groups over time is concerning. These results suggest that changes to the control condition of the experiment are necessary in order to elicit a mindful state in only the mindfulness condition. As there was a main effect of mindfulness but no interaction, the control condition may have experienced a brief increase in mindfulness following the intervention. Therefore, as the control condition should not lead to an increase in state mindfulness, it is imperative that an alternative condition be used as a control in the primary study. Furthermore, it is concerning that the control condition experienced a decrease in positive affect. If it is possible that changes in affect may alter negativity biases (Chen, Yuan, Huang, Chen, &

Li, 2008), a control condition should be selected that, ideally, is not accompanied by any changes in affective state.

In addition to the increase in mindfulness and decrease in positive affect observed in the present study, some research has suggested that mind wandering may activate cognitive processes (such as rumination) that may lead to or enhance a negative bias (Paul et al., 2013; Arch & Craske, 2006). If the mind wandering condition could preferentially lead to ruminatory cognitions in the dysphoric group (Alleva et al., 2014; Paul et al., 2013), such individuals might experience an enhanced negativity bias (Paul et al., 2013; Arch & Craske, 2006). Thus, if there were a significant difference between the dysphoric participants receiving the mindfulness meditation relative to those who received the mind wandering control intervention, it would be difficult to evaluate whether the difference was due to the mindfulness intervention reducing bias or the mind wandering condition-enhancing bias.

Therefore, an alternative control condition was used in the primary study. Unlike mind wandering, which has been associated with rumination (Paul et al., 2013; Arch & Craske, 2006), the use of an audiobook as a control condition appears to be a more neutral condition that is less likely to interact with dysphoria (Zeidan, Johnson, Diamond, David, & Goolkasian, 2010; Johnson, Gur, David, & Currier, 2013; Mirams, Poliakoff, Brown, & Lloyd, 2013).

Furthermore, the decrease in mindfulness between the second and third administration of the SMS in the control group indicates that the act of rating facial expressions and completing both the SMS and PANAS measures may somehow interfere with an individual's mindful state. Alternatively, if the effects of the brief mindfulness

meditation endure for only a short period of time, it is possible that the effects of the meditation had dissipated by the time participants rated any facial expressions. If this is the case, it is critical to remove excess facial expressions and measures so as to ensure that the effects of the brief mindfulness meditation are still present during the affect rating paradigm. Therefore, the primary study used only 6 faces, rather than 20, to assess the negativity bias.

Finally, this pilot project revealed unexpected problems with some of the neutral faces. Exploratory analyses indicated that, despite selecting faces that had been rated as neutral in the Radboud Face Database (Langer, Dotsch, Bijlstra, Wigboldus, Hawk, & Knippenberg, 2010), only a small number received average valence scores within 5 points of 50, which is the midpoint between positive and negative facial expressions in the pilot study. This indicates that not all of the faces used in the study were entirely neutral. Therefore, in the primary study, only faces that had average ratings within 5 points of 50 were considered for inclusion in the primary analysis. Of these faces, preference was given to those with larger standard deviations, which suggested that the facial expressions were perceived as more ambiguous (refer to the following methods section for specific selection criteria; facial means and standard deviations may be found in Table 1).

Primary Study

Introduction

The aim of the primary study was to determine whether a brief mindfulness meditation could reduce a dysphoric sample's negativity bias for ambiguous facial expressions. Recent studies provide some evidence that mindfulness may mitigate the

negativity bias associated with dysphoria (Alleva et al., 2014; Paul et al., 2013; Kiken & Shook, 2011); however, the impact of mindfulness on socially relevant appraisals of ambiguous emotional facial expressions has yet to be explored. To better evaluate the hypothesis that a brief mindfulness intervention may reduce the negativity bias, a number of changes were made from the pilot study. First and foremost, the pilot study suggested that the effects of the brief mindfulness meditation were fleeting. Therefore, 14 faces and the PANAS measure were removed from the primary study to minimize the time between the intervention and the facial rating task and thus to maximize any effect of the intervention on the facial affect ratings. Unfortunately, as a result, if mindfulness does reduce the negativity bias, the present design will be unable to discern whether this decrease was due to changes in cognition or in mood states. Additionally, as the mind wandering control induced a state of mindfulness following the intervention and was associated with cognitive processes that could, theoretically, foster a negativity bias (Paul et al., 2013; Arch & Craske, 2006), it was replaced with an alternative, audiobook control condition. Lastly, the length of both the control and mindfulness interventions was expanded, so as to increase the effect of the manipulation.

Method

Participants

Participants were 78 college students (23 (30%) male, 53 (69%) female, 1 (1%) other; M_{age} = 20.04, SD = 1.38) attending a small liberal arts college in the Midwest. Participants' races and ethnicities were as follows: 46 were Caucasian (63%), 5 African American (6%), 12 Asian (15%), 8 mixed race (10%), 4 Hispanic (5%), 1 Afghani (1%), while 1 participant elected not to provide race or ethnicity information. All participants

enrolled in introductory psychology classes (n = 25) received psychology course credit for their participation in the study. Volunteers recruited from the undergraduate population through social media and college email bulletins (n = 53) received $7 dollars in compensation. Twenty-one participants reported practicing mindfulness meditation for at least one hour per month (M = 1.23 hours, SD = 3.98 hours).

Materials

The Center for Epidemiologic Studies Depression Scale (CES-D) is a widely used 20-item self-report measure for assessing depressive symptomology in the general population (Radloff, 1977). Each of the 20 items is rated on a 4-point Likert scale, ranging from 0 ("Rarely or None of the Time") to 3 ("Most or All of the Time"). To control for considerable week-to-week variability in the typical college student's life, the 1-week reporting period was extended to 1 month. Therefore, participants were asked to report how often over the course of the past month they have experienced each item (e.g. "I had trouble keeping my mind on what I was doing").

When used to assess depressive symptoms in the general population, the CES-D has shown robust internal consistency (coefficient $\alpha = .85$; $\alpha = .93$ in the present study) and reasonable six-month test-retest reliability ($r = .54$). Furthermore, the CES-D correlates well with other scales of depression and has reasonable discriminant validity (Radloff, 1977).

The trait Mindful Attention Awareness Scale (MAAS; see Appendix B) is intended to assess a receptive state of mind in which the individual simply observes what is taking place; this form of attention is a central component of mindfulness (Brown & Ryan, 2003). The trait MAAS is a 15-item measure in which statements are endorsed using

a 6-item Likert scale that ranges from 1 (Almost Always) to 6 (Almost Never). It is among the most commonly used measures of trait mindfulness and has consistently demonstrated robust psychometric properties. Internal consistency levels (Cronbach's α) range from .80 to .90 (Brown & Ryan, 2003; in the present study, $\alpha = .68$). The MAAS has demonstrated high test-retest reliability, with 4 week correlations of $r = .81$, and good discriminant and convergent validity (Brown & Ryan, 2003). Given the established, inverse relationship between trait mindfulness and negativity bias (Teasdale, Segal, Williams, Ridgeway, Soulsby, & Lau, 2000), the MAAS was used to control for stable individual differences in mindfulness that were not otherwise accounted for by initial state mindfulness.

The State Mindfulness Scale (see Appendix C) is designed to evaluate two forms of state mindfulness, the objects of mindful attention (i.e., to 'what' an individual attends, which the authors label "Body") and meta-cognitive state (i.e., how an individual attends, labeled "Mind"). The measure is intended to encompass five facets of a mindful state: "awareness, perceptual sensitivity to stimuli, deliberate attention to the present moment, intimacy or closeness to one's present experience, and curiosity" (Tanay & Bernstein, 2013). The SMS is composed of 21 statements about the participants' experiences over the 15 minutes prior to the survey. The SMS contains a list of statements (e.g., "I was aware of different emotions that arose within me") that participants endorsed using a 5-item Likert scale from 1 (not at all) to 5 (very well). The overall SMS has demonstrated robust internal reliability coefficients, with Cronbach's α ranging from .92 to .97 in four separate samples (SMS_{Mind}: $\alpha = .91$ to .96; SMS_{Body}: $\alpha = .85$ to .89; In this study $SMS_{Mind1} = .90$, $SMS_{Mind2} = .93$, $SMS_{Mind3} = .94$; $SMS_{Body1} = .86$, $SMS_{Body2} = .91$, and

SMS_{Body3} = .91). The α's in the present study were similarly robust and consistent with those reported in the literature (SMS_1, α = .92; SMS_2, α = .95; SMS_3, α = .95). Furthermore, the SMS has been shown to be more sensitive to incremental changes in state mindfulness than the MAAS-S (Brown & Ryan, 2003), another commonly used measure of state mindfulness (Tanay & Bernstein, 2013).

Mindfulness intervention

The meditation intervention consisted of a 19-minute recording identical to that described in the pilot study, supplemented with an additional 4 minutes of audio removed from the original mindfulness intervention in order to shorten the duration of the pilot study (for a transcript of the mindfulness recording refer to Appendix H). Critically, prior research suggests that a 15-minute mindfulness intervention is capable of changing cognitive processes associated with negativity biases, such as rumination (Feldman, Greeson, & Senville, 2010). Similarly, in a non-dysphoric sample, Kiken and Shook (2011) demonstrated that a 15-minute intervention was capable of altering negativity biases for novel stimuli. Thus, an expanded meditation 19 minutes in duration is likely capable of invoking similar effects.

Audiobook control condition

In the audiobook control condition (Zeidan, Johnson, Diamond, David, & Goolkasian, 2010; Johnson, Gur, David, & Currier, 2013; Mirams, Poliakoff, Brown, & Lloyd, 2013), participants were given headphones and instructed to listen to a 19-minute excerpt from the first chapter of *The Hobbit* (Recorded Books Inc., 1991), 'An Unexpected Journey.'

Facial Stimuli

Facial stimuli were 6 validated, neutrally valenced faces (3 male, 3 female) taken from the Radboud Face Database (Langer, Dotsch, Bijlstra, Wigboldus, Hawk, & Knippenberg, 2010; see Appendix D for stimuli). The 6 faces were selected on the basis of neutrality and large standard deviations from the original 20 facial expressions presented in the pilot study. These faces were selected based on their proximity to the perfectly neutral score of 50 on a scale between 0 (more clearly positive) and 100 (more clearly negative). Large standard deviations were incorporated into the selections criteria so as to discern faces that, while neutrally valenced, received the most variable ratings. Consequently, such facial expressions were assumed to be the most ambiguous. The 6 faces were, on average, rated between a 48.2 and a 54.7 (*SD's* ranged from between 11.9 and 17.1).

Procedure

Upon arrival, participants completed a consent form and listened to a script of the facial expression rating instructions read by the author (see Appendix I). Participants were then escorted to a small private testing room containing a desk, chair and computer. Prior to their arrival, an Internet survey administered by the Qualtrics website was loaded on the computer in the testing room. Participants then completed the CES-D, MAAS, and the SMS, presented in a fixed order. Participants were then randomly assigned to one of the two conditions described earlier: a brief mindfulness intervention or the audiobook control condition. Participants received headphones and were instructed to engage with the audio recording associated with their condition to the best of their ability.

Participants next completed a post-test SMS measure to evaluate the effectiveness of the mindfulness manipulation. Upon completion, participants were told that they would be rating hard to detect emotions, or micro-emotions, and were provided with instructions detailing how to rate the emotional faces along with a warning that each face would be presented for a total of 5 seconds. A total of 6 images were presented one at a time for five seconds each; after the face disappeared, a slide bar appeared on the screen. Participants used the slide bar to identify how positive or negative the emotion expressed by the face was (anchors were "More Clearly Positive" and "More Clearly Negative"). Higher scores correspond to more negative appraisals of the facial expressions. To proceed to the next face in the paradigm, participants clicked the "next" button at the bottom of the display. The Qualtrics system randomized the order that faces were presented for each participant.

Lastly, participants completed a final SMS and a brief demographic questionnaire (see Appendix E), in which they were asked to provide information about their gender, age, race, ethnicity and prior mindfulness meditation experience (see Appendix F, adapted from Jislin-Goldberg, Tanay, & Bernstein, 2012). Participants then received a debriefing form, which contained information for college counseling services, and were thanked for their participation in the study.

Experimental Design

To test the central hypothesis, this study employed a mixed design. Dysphoria and mindfulness conditions served as between-subjects variables; CES-D scores at or above 18 corresponded to high dysphoria and those of 15 or less corresponded to low dysphoria. Though individuals scoring above a 15 are considered dysphoric (Radloff, 1977), to

improve resolution between the high dysphoria and low dysphoria groups, participants scoring a 16 or 17 were omitted from the primary analyses. The dependent variable was the sum of each participant's ratings of the relative negativity of the male and female neutrally valenced facial expressions validated in the pilot study. In this study, a rating of 50 for the average of all 6 faces corresponds to a truly neutral appraisal score. Participants' trait mindfulness scores were included as covariates in some analyses.

Results

Potential Confounders and Manipulation Check:

Of the 78 participants, 36 had low dysphoria scores (CES-D scores ≤ 15, $M = 9.7$, $SD = 4.3$) and 28 participants had high dysphoria scores (CES-D scores ≥ 18, $M = 26.8$, $SD = 10.7$); fourteen participants had CES-D scores between the criteria for the low dysphoria and high dysphoria groups and were excluded from the primary analyses. To confirm that there were no significant differences between groups at the outset of the study with respect to trait mindfulness (MAAS), state mindfulness (SMS), dysphoria (CES-D), number of years meditating and number of hours spent engaging in mindfulness meditation each month, a MANOVA was performed using condition (mindfulness, control) as the independent variable. There were no significant differences between the mindfulness condition and the audiobook control condition, $F(5, 74) = .78$, *n.s.* (means and standard deviations available in Table 2).

To assess whether participants who were recruited and received monetary compensation for their participation differed from those participating in the study for credit, an additional MANOVA was conducted using compensation (monetary, credit) as the independent variable; the dependent variables remained the same. There were no

significant differences between groups, $F(1, 74) = .92$, *n.s.* (means and standard deviations available in Table 3). Although group differences between introduction to psychology participants receiving credit and students receiving financial compensation should be evaluated using an interaction model that includes the mindfulness and audiobook control conditions, there were insufficient numbers of participants in each cell to make such analyses viable.

A repeated measures ANOVA was conducted to verify that the mindfulness intervention successfully induced a mindful state relative to the audiobook control condition. Six participants were missing multiple items on either the initial or second SMS and were consequently excluded from the analysis. The analysis revealed a significant increase in state mindfulness scores on the SMS between the first and second administration, $F(1, 70) = 14.35$ $p < .001$, $\eta^2 = .17$. Critically, there was a significant interaction, $F(1, 70) = 19.42$, $p < .001$, $\eta^2 = .22$, such that while there was no difference between groups initially (refer to Table 4 for means and standard deviations), ($M_{\text{mindfulness}} = 68.11$, $SD = 15.46$; $M_{\text{control}} = 69.74$, $SD = 16.03$), the mindfulness condition reported significantly higher state mindfulness scores ($M_{\text{mindfulness}} = 82.89$, $SD = 15.00$) after the intervention, whereas the control group's level of state mindfulness remained constant ($M_{\text{control}} = 68.63$, $SD = 15.62$). Post-hoc paired *t*-tests indicated those in the mindfulness condition were significantly more mindful following the intervention, $t(36) = 7.07$, $p < .001$; participants in the control condition experienced no significant change in mindfulness before and after the control intervention, $t(34) = .37$, *n.s.* (see Figure 3). Thus, the mindfulness intervention successfully induced a state of mindfulness, and the control condition did not influence mindfulness.

Primary Analysis:

To evaluate the negativity bias, participants' ratings of each of the 6 neutrally valenced faces were summed together into a composite score (where higher scores indicate greater negativity), which served as the dependent variable in a 2 (dysphoria) x 2 (condition) between subjects ANOVA. Consistent with past research, there was a main effect of dysphoria on the valence of the facial expressions, $F(3, 60) = 11.47$, $p = .001$, $\eta^2 = .16$, such that the high dysphoria group ($M = 59.3$, $SD = 9.0$) appraised the faces as significantly more negative than the low dysphoria group ($M = 52.6$, $SD = 7.1$). Additionally, there was no significant main effect of mindfulness, $F(3, 60) = .12$, *n.s.* Contrary to hypotheses, the interaction effect was not significant, $F(3, 60) = 2.075$, *n.s*. However, when controlling for the effects of trait mindfulness in the analysis, the interaction became marginally significant, $F(3, 60) = 3.01$, $p = .088$, $\eta^2 = .049$ (refer to Table 5 for descriptive statistics). Post-hoc ANCOVA analyses employing trait mindfulness as a covariate found no significant differences between mindfulness and control groups among participants reporting low dysphoria scores, $F(1, 35) = 2.49$, *n.s.,* and those reporting high dysphoria, $F(1, 26) = 1.09$, *n.s.* Though not significant, this finding is consistent with my hypothesis such that within the high dysphoria groups, those who had received the mindfulness intervention evaluated faces as less negative ($M = 57.0$, $SD = 9.6$) than those in the control group ($M = 60.5$, $SD = 6.8$). However, intriguingly, the control condition in the low dysphoria group ($M = 50.8$, $SD = 5.9$) evaluated the faces as less negative than did those in the mindfulness condition ($M = 54.4$, $SD = 7.8$; see Figure 4).

Exploratory Analyses:

A large number of subjects were excluded from the above analysis because their CES-D scores fell in the midrange between the low and high dysphoria groups. Losing 18% of the sample led to a corresponding loss in power. Therefore, an exploratory analysis was conducted to evaluate whether a median split between groups that enabled a more powerful analysis, albeit with less resolution between groups, would alter the pattern of results. Although the negativity bias was again evident in this analysis, $F(3, 76) = 4.68$, $p = .03$, $\eta^2 = .062$, the interaction effect was no longer marginally significant, $F(3, 76) = 2.15$, *n.s*. Despite the greater power of this analysis, the non-significant result may be attributed to the loss of resolution between groups due to the median split.

Additionally, to evaluate whether the mindful state induced by the mindfulness manipulation endured until after the facial affect rating, I conducted a 2 (SMS post-intervention, SMS post-facial affect rating) x 2 (mindfulness, control) repeated measures ANOVA. There was a significant main effect of time, $F(1, 70) = 67.71$, $p < .001$, $\eta^2 = .49$, such that the participants were significantly less mindful following the facial affect rating than immediately following the intervention. Furthermore, there was a significant interaction between the intervention and the timing of the SMS administrations, $F(1, 70) = 6.70$, $p = .01$, $\eta^2 = .09$. Post-hoc paired *t*-tests indicated there was a significant decrease in mindfulness scores from the post-intervention rating ($M = 82.9$, $SD = 15.0$) to the post-facial affect rating SMS in the mindfulness group ($M = 64.8$, $SD = 18.1$), $t(36) = 8.17$, $p < .001$. Likewise, the control condition also experienced a significant decrease in state mindfulness from immediately after the intervention ($M = 68.6$, $SD = 15.6$) to following the facial affect rating ($M = 59.7$, $SD = 18.8$), $t(34) = 3.74$, $p = .001$ (see Figure 5).

Although both conditions experienced a decrease in mindfulness following the facial affect-rating paradigm, the mindfulness group condition experienced a more drastic decrease. This sharper decrease was primarily due to the group's significantly higher mindfulness scores immediately following the mindfulness intervention. These results suggest that the effect of the brief mindfulness intervention did not persist over time. The completion of the SMS and facial affect-rating paradigm may have resulted in participants becoming significantly less mindful. Alternatively, the effect of the mindfulness meditation may be innately fleeting. However, either explanation justifies the removal of the PANAS measure, which would have either contributed actively to the erosion of the mindful state or simply wasted precious minutes during the short window of mindfulness.

To examine whether the mindfulness meditation differentially influenced the cognitive and bodily components of mindfulness meditation separate 2 (mindfulness, control) x 3 (SMS_1, SMS_2, SMS_3) repeated measures ANOVAs were conducted for both the 'Body' and 'Mind' subscales of the SMS. In the first analysis of the 'Mind' subscale of the SMS, which was designed to evaluate an individual's meta-cognitive state, there was a significant main effect of mindfulness over time, $F(2, 69) = 25.27$ $p < .001$, $\eta^2 = .42$. Specifically participants experienced a brief increase in mindfulness immediately following the intervention, which rapidly dissipated by the completion of the facial affect rating task. Importantly, there was also a significant interaction of 'Mind' SMS scores over time and the intervention, $F(2, 69) = 6.31$, $p = .003$, $\eta^2 = .16$. Post-hoc paired *t*-tests indicated that there was a significant increase in mindfulness from baseline ($M = 48.8$, $SD = 11.1$) to post-intervention ($M = 59.2$, $SD = 10.8$), $t(36) = 6.93$, $p < .001$, for the

mindfulness condition. However there was a significant decrease in 'Mind' SMS scores, or meta-cognitive mindfulness, from the intervention (M = 59.2, SD = 10.8) to the completion of the facial affect rating paradigm (M = 49.78, SD = 13.2), $t(36) = 5.78$, $p < .001$. In the control condition there were no significant differences between baseline (M = 50.7, SD = 11.4) and post-intervention 'Mind' SMS scores (M = 52.4, SD = 11.6), $t(35) = .82$, *n.s.* However, there was a significant decrease in 'Mind' SMS scores from the intervention (M = 52.2, SD = 11.6) to after the completion of the facial affect rating paradigm (M = 46.9, SD = 14.4), $t(34) = 2.86$, $p = .007$.

A similar pattern of results was observed for the 'Body' subscale of the SMS. Specifically, there was a significant main effect of 'Body' SMS scores over time, $F(2, 70) = 42.50$, $p < .001$, $\eta^2 = .55$, such that there was a decrease in SMS 'Body' mindfulness scores over the course of the experiment. However, there was also a significant interaction effect of SMS score over time and intervention, $F(2, 70) = 12.62$, $p < .001$, $\eta^2 = .27$. Post-hoc paired t-tests indicated that the mindfulness condition experienced a significant increase in 'Body' mindfulness scores from baseline (M = 19.3, SD = 6.2) to post-intervention (M = 23.7, SD = 4.8), $t(36) = 4.76$, $p < .001$. However, there was a significant decrease in 'Body' SMS scores following the intervention (M = 23.7, SD = 4.8) to after the completion of the facial affect rating paradigm (M = 15.0, SD = 6.3), $t(36) = 8.51$, $p < .001$. In contrast, the control condition experienced significant decreases in 'Body' SMS scores from baseline (M = 19.0, SD = 6.2) to post-intervention (M = 16.5, SD = 5.7), $t(35) = 2.15$, $p = .038$, and from post-intervention (M = 16.8, SD = 5.9) to following the completion of the facial affect rating paradigm (M = 12.9, SD = 5.6), $t(36) = 3.86$, $p < .001$.

Discussion

The primary purpose of the present study was to evaluate whether a brief mindfulness intervention could interact with the cognitive processes thought to give rise to negative interpretation biases in individuals experiencing dysphoria. Specifically, it was hypothesized that the acceptance and non-reactivity components of mindfulness meditations might interrupt the ruminative and dysfunctional cognitive processes that underlie the development and maintenance of negativity biases (Alleva et al., 2014; Paul et al., 2013). Although the exclusion of participants whose CES-D scores fell between the specified cutoffs for the low and high dysphoria conditions greatly reduced the power of the present analysis, the marginally significant effect is consistent with the hypothesis. Specifically, the marginally significant result suggests that individuals who experience high levels of dysphoria and receive a brief mindfulness intervention perceive facial expressions as less negative than those who received a control condition, thereby providing tentative support for the hypothesis that a brief mindfulness meditation may reduce negativity biases present in individuals with high levels of dysphoria (Paul et al., 2013; Kiken & Shook, 2011).

Furthermore, this study complicates previous results reported by Kiken and Shook (2011) and Paul and colleagues (2013). Specifically, in the present study there was no main effect of mindfulness. Instead the mindfulness meditation led to a marginally significant reduction in negativity bias only for the high dysphoria group. Both Kiken and Shook (2011) and Paul et al. (2013) found evidence that brief mindfulness meditations are capable of reducing negativity biases present in individuals who are not dysphoric. Furthermore, Kiken and Shook (2011) provided evidence to suggest that the mindfulness

intervention was capable of inducing a positivity bias in attitudes towards novel stimuli. Although negativity biases vary depending on the nature of the stimuli used to assess them (Cowden Hindash & Amir, 2012; Beevers, Wells, Ellis, & Fischer, 2009), no analogous positivity bias or reduced negativity bias was observed in the low dysphoria condition. Specifically, the low-dysphoria group that received the mindfulness intervention appraised faces as more negative than those in the control condition (although this finding was non-significant). However, like Kiken and Shook (2011), the present results provide further nuanced support for the hypothesis that brief mindfulness meditations are capable of reducing negativity biases, though this effect was only observed for those with high levels of dysphoria. Additionally, this study complements findings by Paul and colleagues (2013) by suggesting that mindfulness interventions (as opposed to innate trait mindfulness) may be capable of reducing negativity biases.

However, as the interaction was only marginally significant, and follow up tests revealed no significant differences, these results should be interpreted with caution. Although the present analyses received an 18% drop in power and still yielded a marginally significant result, the effect size is relatively small. Thus, a large sample may be necessary to detect any significant results. Furthermore, as facial expressions were rated consistently more negatively by individuals in the high dysphoria condition compared to the low dysphoria condition, this study validates the use of the neutrally valenced facial expressions in the evaluation of the negative interpretation bias.

Although the above results support the primary hypothesis that mindfulness reduces negativity bias for those with high levels of dysphoria, the exclusion of mood scales in the primary analyses (so as to maximize the effect of mindfulness meditation on

facial affect appraisal) precludes evaluation of the secondary hypotheses in the present study. Specifically, the present study cannot determine whether mood or cognitive factors are motivating the change in interpretation bias. Furthermore, as the effect of the mindfulness intervention was fleeting in the present study, it is possible that any fluctuations in mood might be similarly brief and thus difficult to detect in such a short intervention. However, as this study has established the impact of the mindfulness and control interventions on state mindfulness scores, in future studies, the SMS measure may be omitted from the experimental design. Such a change would allow for the collection of mood information despite the fleeting change in mindfulness to investigate whether any reductions in bias are associated with changes in mood. However, ideally, the effect of the mindfulness meditation would persist for a longer period of time to allow both cognitive and affective variables to be assessed simultaneously.

Prior studies have suggested that brief mindfulness interventions are capable of temporarily changing a number of dysfunctional cognitions (such as rumination) that are thought to contribute to the genesis and maintenance of negative interpretation biases (Feldman, Greeson, & Senville, 2010). However, given the evanescent nature of the mindfulness effect elicited by this intervention, the present study suggests that the practical application of brief mindfulness meditations are severely limited. Many of the therapeutic changes in cognitive processes have been most reliably demonstrated in interventions that occur over months or years (Brown & Ryan, 2003; Kang, Gruber, & Gray, 2013; Williams, 2008). Therefore, the tentative hints of an effect in the present study provide some provisional evidence to suggest that a longer and more intensive practice of mindfulness might in fact change how individuals experiencing a negativity

bias perceive ambiguous emotional information, particularly ambiguous facial expressions.

Furthermore, mindfulness is a construct that can be defined in a wide variety of ways (Tanay & Bernstein, 2013; Brown & Ryan, 2003). A number of interventions have been developed to foster different components of the mindfulness construct. The intervention used in this study was framed as a body scan, though elements of non-reactivity, acceptance, and non-judgment were incorporated in the audio recording. However, compared to other mindfulness meditations, body scans may have a comparably reduced effect on cognitive processes. As ruminatory cognitions and other dysfunctional cognitive styles are thought to be causally linked to the formation and maintenance of negativity biases (Paul et al., 2013), a brief meditation that focuses less on the cognitive facets of mindfulness may not have sufficient power to alter cognitive processes. However, the body scan meditation used in this study, though originally selected as a form of meditation that would be easily accessible to participants without prior training, induced a significant increase in 'Mind' or meta-cognitive state mindfulness. Though the effect was brief, the ability of the body scan meditation used in this study to increase cognitive components of mindfulness (such as awareness, deliberate attention to the present moment, intimacy or closeness to one's present experience, and curiosity; Tanay & Bernstein, 2013) suggests that the marginally significant interaction could perhaps be due to cognitive changes. However, as the construct of mindfulness is very broad, the SMS 'Mind' scale may not directly evaluate processes such as non-reactivity, which may be more pertinent to negativity biases.

Despite the study's strengths, there are also a number of weaknesses in the present design. Of greatest concern is the short temporal duration of the mindful state induced by this manipulation. The evanescent nature of the mindfulness benefits raises concerns that the nature of the mindful state elicited in this study may differ from the more enduring, cultivated mindfulness that is characteristic of multi-month or yearlong intervention programs. Additionally, the present sample included a number of individuals who had scores within the clinical range on the CES-D. The literature suggests that dysphoria and depression are best characterized on a continuum; they appear to be very similar phenomena that differ in symptom severity (Austin, Mitchell, & Goodwin, 2001). Nonetheless, it is possible that there are aspects of these conditions that are better characterized as separate phenomena. Therefore, future studies should use a more homogenous dysphoria sample to ensure that differences in cognition or other underlying processes pertinent to the development of the negativity bias remain constant within the sample. Given that the majority of individuals in the high dysphoria group had CES-D scores on the lower end of the high dysphoria cutoff, the few individuals with very high CES-D scores likely had a minimal impact on the present results. However, with a larger sample size, it would be possible to control for skew or to establish an upper cutoff for eligible dysphoria scores to ensure the integrity of the results. Additionally, future studies would benefit from a pre-screening protocol to ensure those participants with high dysphoria scores or those who score in a range between the high and low dysphoria groups do not participate in the study.

The present study has a number of strengths, including the use of well-validated stimuli to detect differences in affect appraisal. Furthermore, there was a strong main

effect of dysphoria, such that individuals with high dysphoria scores perceived facial expressions as more negative than their low dysphoria peers. This result is indicative that the ambiguous facial expressions used in this study are indeed stimuli that are susceptible to the negativity bias.

However, as the duration of the mindful state induced by these interventions was fleeting, future studies should adopt a longer mindfulness training paradigm, which has been shown to effect more enduring change in mindfulness. Such studies, especially with a clinical population, would also clarify mindfulness meditation's ability to reduce negativity biases as a part of a therapeutic intervention. Alternatively, the fleeting nature of the mindful state induced by the brief mindfulness intervention might be partially attributable to the experimental design. Specifically, participants were asked to make judgments about facial stimuli, however as a facet of mindfulness is entering a non-judgmental state perhaps the act of making judgments hastened the decrease in mindfulness. Therefore future studies may seek to adopt a form of facial affect appraisal that is more naturalistic so as to reduce the possible impact of judgment on a participant's mindful state.

In conclusion, the present study provides tentative support for the hypothesis that mindfulness meditation is capable of reducing negativity biases for ambiguous facial expressions. Although the evanescent effect of the mindfulness meditation precluded any claims regarding whether mood (Kiken & Shook, 2014; Johnsons, Gur, Favid, & Currier, 2015) or cognitive (Paul et al., 2013) changes underlie the change in negativity bias, the marginally significant results (despite the poorly powered analysis) are a cause for optimism that mindfulness meditations may indeed attenuate negativity biases.

Furthermore, this study supports the presence of negativity biases in non-clinical dysphoric samples and provides support for the use of ambiguous facial expressions as a measure of such biases.

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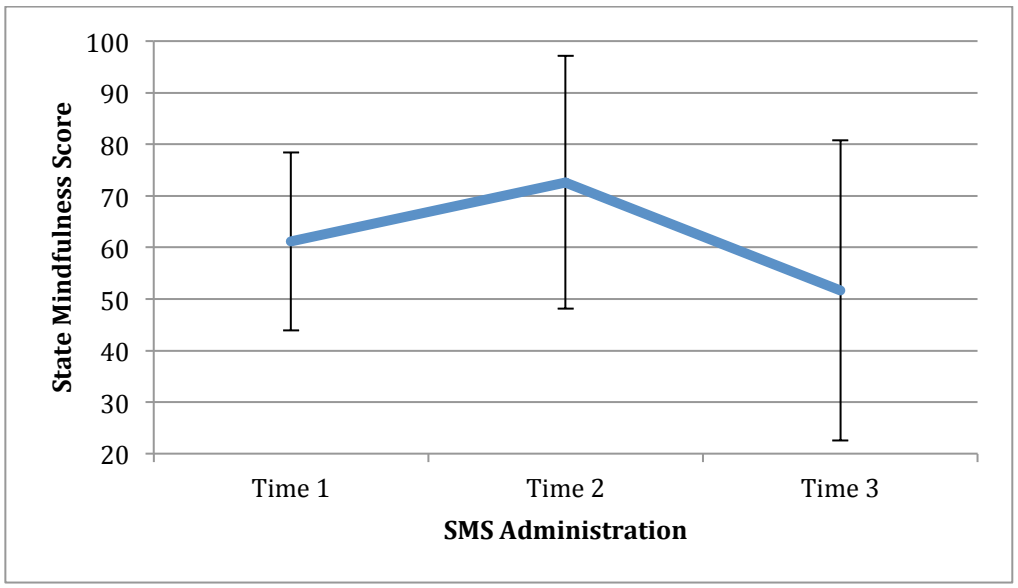

Figure 1. State mindfulness scores over time. Significant differences were observed between times 1 and 2 and also between times 2 and 3.

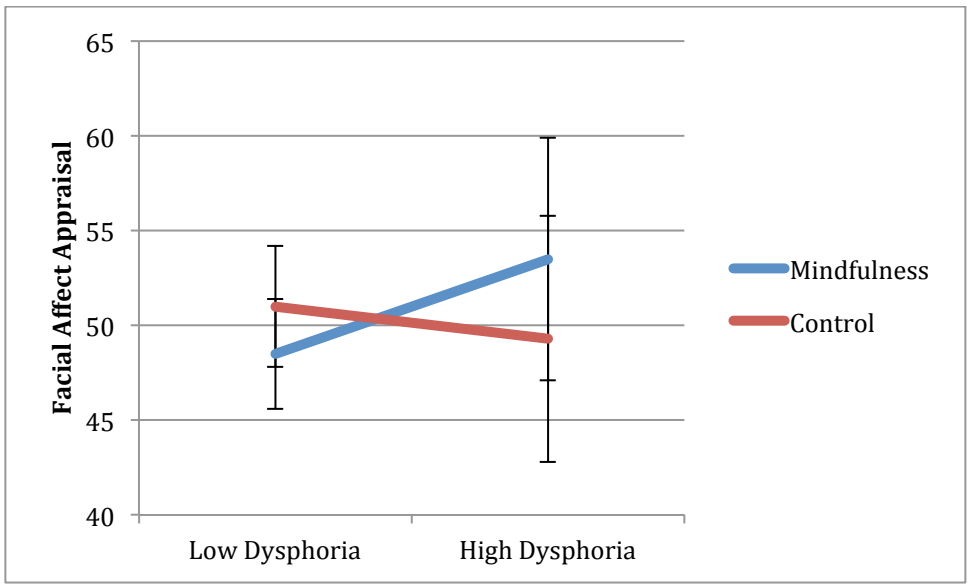

Figure 2. Marginally significant interaction of meditation intervention and dysphoria condition. Significant differences were observed between the low and high dysphoria conditions in the mindfulness meditation intervention. Higher values indicate greater appraisal negativity.

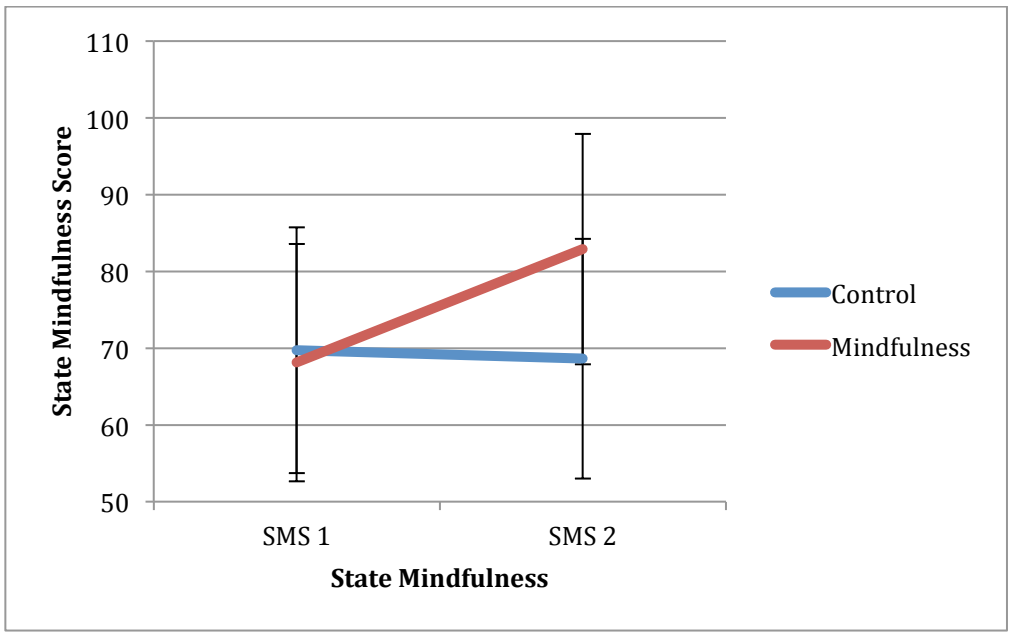

Figure 3. Significant interaction effect of state mindfulness following the brief mindfulness intervention. Significant increases in state mindfulness were observed in the mindfulness group while the control group reported no change in state mindfulness following the control intervention.

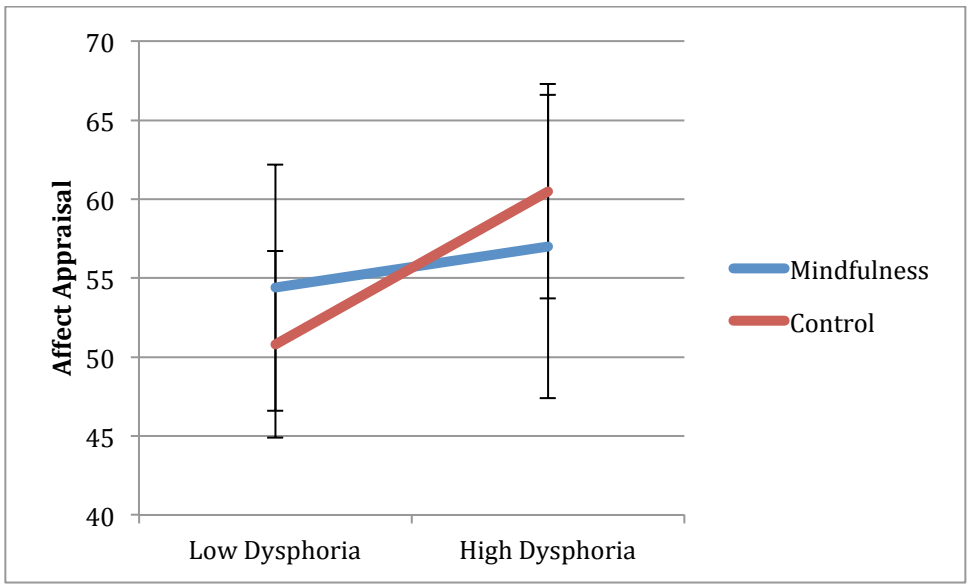

Figure 4. Appraisal of ambiguous facial expression valence by dysphoria group and mindfulness condition, controlling for trait mindfulness. Higher values indicate greater appraisal negativity.

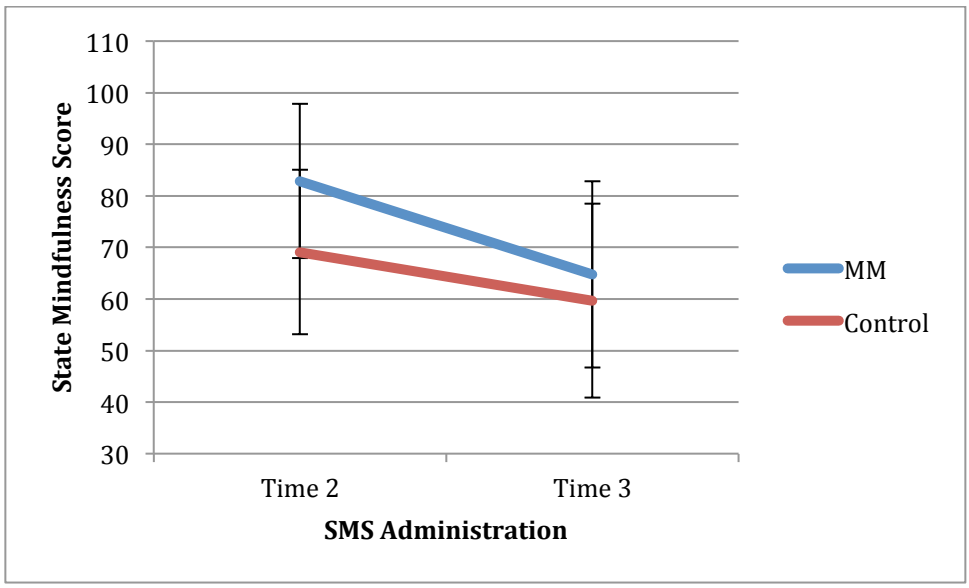

Figure 5. SMS scores following the mindfulness and control interventions (time 2) and after the affect rating paradigm (time 3).

Table 1. Means and standard deviations for 20 faces included in the pilot study from the Radboud Face Database (Langer, Dotsch, Bijlstra, Wigboldus, Hawk, & Knippenberg, 2010).

Face	Mean	SD
1	58.69	11.24
2	63.14	13.20
3	40.89	14.62
4	41.06	16.11
5	56.97	14.89
6	46.74	8.01
7	50.94	14.14
8	54.71	14.00
9	52.14	13.04
10	48.23	12.47
11	53.26	17.12
12	52.23	10.38
13	56.66	11.00
14	29.74	14.82
15	62.66	15.98
16	45.26	9.76
17	43.09	11.58
18	61.34	15.75
19	47.31	10.98
20	50.89	11.86

Table 2. Means and standard deviations for CESD, initial SMS, MAAS, hours spent practicing mindfulness meditation each month (Mind), and number of years practicing meditation (Years).

Measure	**Group**	**Mean**	***SD***
SMS	Mindfulness	68.11	15.46
	Control	69.35	15.75
CESD	Mindfulness	17.30	10.71
	Control	16.03	7.62
MAAS	Mindfulness	4.42	.74
	Control	4.42	.76
Mind	Mindfulness	2.05	5.42
	Control	.47	1.49
Years	Mindfulness	.97	5.42
	Control	.54	1.37

Table 3. Means and standard deviations for participants receiving credit and monetary compensation (Financial) based on initial SMS, CESD, MAAS, hours spent practicing mindfulness meditation each month (Mind), and number of years practicing meditation (Years).

Measure	**Group**	**Mean**	***SD***
SMS	Credit	69.70	14.55
	Financial	68.29	16.05
CESD	Credit	15.96	12.00
	Financial	16.98	7.83
MAAS	Credit	4.61	.59
	Financial	4.34	.80
Mind	Credit	2.00	6.22
	Financial	.931	2.51
Years	Credit	.71	1.43
	Financial	.77	1.63

Table 4. Means and standard deviations at baseline and post control or mindfulness intervention. Higher scores reflect greater state mindfulness.

Condition	Time	Mean	SD
Control	Baseline	69.74	16.03
	Post-Intervention	68.63	15.62
Mindfulness	Baseline	68.11	15.46
	Post-Intervention	82.89	15.00

Table 5. Means and standard deviations by dysphoria condition and mindfulness or control intervention. Higher scores indicate greater negativity.

Intervention	Dysphoria Condition	Mean	SD
Mindfulness	Low Dysphoria	54.4	7.8
	High Dysphoria	57.0	9.6
Control	Low Dysphoria	50.8	5.9
	High Dysphoria	60.5	6.8

Appendix A

CES-D

Instructions for questions: Below is a list of the ways you might have felt or behaved. Please mark down how often you have felt this way during the past month.

Rarely or None of the Time
Some or Little of the Time
Occasionally or a Moderate Amount of Time
Most or All of the Time

<u>During the past month:</u>

1. I was bothered by things that usually don't bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake of the blues even with the help from my family or friends.
4. I felt that I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life had been a failure.
10. I felt fearful.
11. My sleep was restless.
12. I was happy.
13. I talked less than usual.
14. I felt lonely.
15. People were unfriendly.
16. I enjoyed life.
17. I had crying spells.
18. I felt sad.
19. I felt that people dislike me.
20. I could not get "going."

Appendix B

Day-to-Day Experiences

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5 6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5 6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5 6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5 6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5 6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5 6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5 6
I rush through activities without being really attentive to them.	1	2	3	4	5 6

1 Almost Always	2 Very Frequently	3 Somewhat Frequently	4 Somewhat Infrequently	5 Very Infrequently	6 Almost Never

I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6
I drive places on 'automatic pilot' and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

Appendix C

State Mindfulness Scale:

[Note: The third State Mindfulness Scale will have the following instructions: "There is a list of statements below. Please use the rating scale to indicate how well each statement describes your experience in the past few minutes.]

There is a list of statements below. Please use the rating scale to indicate how well each statement describes your experience in the past 15 minutes.

1	2	3	4	5
Not at all	A little	Somewhat well	Well	Very

1. ___ I was aware of different emotions that arose within me
2. ___ I tried to pay attention to pleasant and unpleasant sensations
3. ___ I found some of my experiences interesting
4. ___ I noticed many small details of my experience
5. ___ I felt aware of what was happening inside of me
6. ___ I noticed pleasant and unpleasant emotions
7. ___ I actively explored my experiences in the moment
8. ___ I clearly physically felt what was going on in my body
9. ___ I changed my body posture and paid attention to the physical process of moving
10. ___ I felt that I was experiencing the present moment fully
11. ___ I noticed pleasant and unpleasant thoughts
12. ___ I noticed emotions come and go
13. ___ I noticed various sensations caused by my surroundings (e.g., heat, coolness, the wind on my face)
14. ___ I noticed physical sensations come and go
15. ___ I had moments when I felt alert and aware
16. ___ I felt closely connected to the present moment
17. ___ I noticed thoughts come and go
18. ___ I felt in contact with my body
19. ___ I was aware of what was going on in my mind
20. ___ It was interesting to see patterns of my thinking
21. ___ I noticed some pleasant and unpleasant physical sensations

Appendix D

The following 20 faces each convey a hard to detect emotional expressions. Each face will be presented for 5 seconds, after which the face will disappear and a slide bar will appear on your screen. Please move the slide marker on the scale to indicate how positive or negative you think each emotional expression was. The slide bar is a continuous scale from 0 to 100, where 0 is clearly more positive than negative and 100 is clearly more negative than positive. After you have rated the facial expression please click the next button to see the next face in the series.

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

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Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Clearly More Positive Than Negative -- slide bar -- Clearly More Negative Than Positive

Appendix E
Demographic Questions

Please enter your age in the box below:

Please enter your gender in the box below:

Please enter your race/ethnicity in the box below:

Appendix F
Adaptation of the Mindfulness Experience Questionnaire

In the box below please indicate how many years, if any, you have been meditating.

[X]

In the questions below we ask you in more detail about your meditation experience. You can restrict yourself to the practices that form an important part of your practice.

How many hours do you practice **mindfulness** meditation each **month** (type 0 if you do not meditate): _____

How many hours do you practice **non-mindfulness** meditation each **month** (type 0 if you do not meditate): _____

Appendix G

The following 6 faces each convey a hard to detect emotional expression. Each face will be presented for 5 seconds, after which the face will disappear and a slide bar will appear on your screen. **Please move the slide marker on the scale to indicate how clearly you detected positive or negative emotional expressions in the face**. A rating of **0** indicates that you clearly detect a positive emotional expression in the face. While a rating of **100** indicates that you clearly detect a negative emotional expression in the face.

After you have rated the facial expression please click the next button to see the next face in the series.

More Clearly Positive -- slide bar -- More Clearly Negative

More Clearly Positive - - - - slide bar - - - - More Clearly Negative

More Clearly Positive - - - - slide bar - - - - More Clearly Negative

More Clearly Positive - - - - slide bar - - - - More Clearly Negative

More Clearly Positive - - - - slide bar - - - - More Clearly Negative

More Clearly Positive - - - - slide bar - - - - More Clearly Negative

Appendix H

The following is a script of the brief mindfulness meditation used as a stimulus in the primary study. Silences, indicated below, usually spanned from 8 seconds to 20 seconds.

Silence

So we're going to do a little body scan mindful meditation right now. So, first of all, I'd just like you to take a moment to come into the body. Let your feet be planted down on the floor. Spine nice and straight. Shoulders relaxed. Chest Open. You can let your eyes close. Your arms on your knees or comfortably in your lap as long as your arms are comfortable at your side. And first just take a moment and notice what it feels like to be sitting here. Notice if you're holding tension in your body anywhere. If you are, just let that go.

So we'll start with just a couple of nice deep breaths. So breathing through the nose, let the breath drop into the body, nourishing the body and then follow the breath gently back out. We'll just do three breaths before we begin the body scan.

Breathing In. And following the breath back out.

And breathing in through the nose, filling up the body, and letting the breath back out.

And one more time, a nice deep breath through the nose, nourishing the entire body. And letting the breath back out.

So now we'll begin the body scan. Really all it is is attending to the body. We'll start at our feet and work our way up to the top of the head. So it's really a noticing, a compassionate being with the body, it's not an attempt to change anything or achieve anything. It's just honoring being attentive to our experience.

So we'll start at the bottom of the feet. I just want you to bring your attention to the bottom of the feet and notice. Maybe you notice some energy, it could be temperature changes, it could even be an itch or a slight discomfort. So whatever it is, as we move through the body, just noticing. So first bring your awareness to the bottom of the feet.

Silence

As we move through anywhere where you notice clenching, holding tension, you can see if you can allow that to drop off and relax.

Silence

And now we'll move up to the top of the foot. Again, same thing, just noticing are there any sensations. Noticing the movement of energy, any clenching. Also as we move through, tending to, let's see if you can do it with an appreciative attitude. So really honoring and appreciating the body.

And now we'll move up into the ankle. So there's a lot of activity there. The ankles, absorbing a lot of stress and pressure and also have the magical ability to move us around on two feet. So noticing if you're holding tension.

Silence

You can also just breathe relaxation into each of the areas as we move into them.

Silence

5:07:
Now moving up into the calves.

Silence

And same thing there, just noticing if you're holding any tension, noticing any sensations. You might notice if there's a difference between where your clothing is touching the skin and where its not.

Silence

Progressively as we move through the body and the mind calms a little bit, becoming even more attentive to the details. What does it really feel like? What is your experience of being in the body?

And moving to the front of the lower legs and the shins.

Silence

You might notice there is a difference from one leg to the other leg. So just being curious about it. No need to change it. Even if there's a slight discomfort, see if you can just tend to it so there's an acceptance and an allowing, as we apply mindfulness to our experience.

6:44:
Silence

And now moving up into the knees.

Silence

Again another area with complex activity, coordination, our knees are also absorbing a lot of pressure. A lot of activity. So bringing an appreciation to that area.

And then just exploring. What does it feel like?

Silence

Also bring some light and relaxation, so just breathing into the knees.

Silence

8:04:
Now you could bring your awareness to the back of the knees, behind the kneecap, back of the leg.

Silence

Is that a different experience than the front of the knee?

And we'll move up into the back of the thighs. Again scanning for any tension or clenching and letting go.

Silence

Maybe experiencing the way the thighs are connecting the knee and the lower leg with the torso.

Silence

Moving up into the top of the thigh.

Again just checking, to see if there's any tension there. And then we'll move into the lower chakra, the groin area. We're going to move up into the torso. A lot of energy there as we move into the torso, and all the internal organs. So just noticing in the lower chakra, just noticing, probably some energy moving through. If you can relax into, be open to the experience.

Silence

10:05:
Especially with the internal organs, a lot more, differentiation between heat and cold and moving energy.

And now moving slightly up into the lower abdomen and the hips.

Silence

Again, just relaxing. Noting any sensation.

Silence

Coming around to the lower back.

Silence

See if you can really stay plugged into well-defined differentiation, moving over an inch or two in one direction or another. Does it feel different? Are you having a sensation somewhere, really being able to identify is that sensation stationary? Is it hot? Is it cold? Is it pleasurable? Is it painful?

11:37:
Silence

And moving up into the middle back.

Silence

Also include the kidneys.

Silence

And moving around to the front and the upper abdomen, again there's a lot of energy moving there. You're being sustained 24/7 by the activity of the body and the internal organs.

Silence

So at once just attending with a curiosity but also just showing our gratitude.

Silence

And now we'll move up into the ribcage, into the lungs.

Silence

As you're breathing in, really experiencing the lungs filling up.

Silence

13:27:
Noting that in the entire body, and also noting if you take a nice deep full breath what is the effect on the rest of the body.

Silence

Considering all the hard work the lungs do, literally bringing us nourishment of oxygen, air.

And then moving into the heart. A vital organ all cultures recognize its vital place, not only pumping blood, but it has a more profound place in our experience as a human being. So just checking in, what's in your heart right now?
Silence

So you're not only aware of the physical content but the emotional content as well.

14:41:
Silence

And just allowing, it might be a complicated mix of things, just allowing for that.

Silence

And we're moving into the upper back.

Silence

And into the shoulders.

Silence

And up into the neck.

15:21:
Silence

And again just relaxing as we move.

Front of the Neck.

And into the jaw.

Silence

Up into the chin and the lips.

Silence

Bringing your awareness to the cheeks.

Silence

And the eye sockets

Silence

To the eyebrow and forehead.

And around to the temple, the side of the skull, to the back of the skull.

Silence

16:55:
And then finally right up to the top of the skull.

Silence

Holding your attention there for a moment.

Silence

And I'll ask you to take a nice deep breath. In through the nose. Drop into the belly. As you exhale, exhale out, right out through the top of the head. Just imagine that happening.

Silence

And we'll finish with just an overall scan or just a cleansing. Taking a breath in and allowing that breath to fill the entire body, that whole trip that we just took. On the exhale, releasing all excess tension, just letting it go.

18:24:
Silence

When you're ready you can let your eyes open.

Silence

And just take a moment before you're ready to be on your way, and thank you.

Silence
End Audio: 18:55

Appendix I

Script:

At a point later in this experiment you will be prompted with a screen that will explain how to rate a series of 6 faces. The instructions will be presented to you before you begin rating, however, in the interest of clarity, I will verbally explain them to you now.

You will be asked to rate the emotions of 6 facial expressions. Each of these faces will be presented for a total of five seconds and each conveys a subtle emotional expression.

Once the five-second period is complete, you will be asked to rate the facial expression you just saw based on how clearly you detected positivity or negativity in the expression.

To rate the facial expression you will use a sliding scale that ranges from 0 to 100. Please feel comfortable using the entire 0 to 100 range. In this range a rating of 0 indicates that you clearly detect a positive emotional expression in the face. While a rating of 100 indicates that you clearly detect a negative emotional expression in the face.

Before we begin do you have any questions?

Acknowledgements

I am incredibly grateful to Professor Darcy Burgund and Mia Nosanow for their feedback on this research project. I would also like to thank Reverend Marc Anderson for recording the mindfulness and mind wandering control stimuli. Lastly, I would like to thank Professor Jaine Strauss for her invaluable mentorship and assistance.