Effects of Mindfulness-Based Stress Reduction on Emotional Experience and Expression: A Randomized Controlled Trial

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Objectives: Mindfulness-based stress reduction (MBSR) has been found to reduce psychological distress and improve psychological adjustment in medical, psychiatric, and nonclinical samples. We examined its effects on several processes, attitudes, and behavior patterns related to emotion regulation. Design: Fifty-six adults were randomly assigned to MBSR or to a waiting list (WL). Results: Compared with WL completers ($n = 21$), MBSR completers ($n = 20$) reported significantly greater increases in trait mindfulness and decreases in absent-mindedness, greater increases in self-compassion, and decreases in fear of emotions, suppression of anger, aggressive anger expression, worry, and difficulties regulating emotions. The WL group subsequently received MBSR, and the two groups combined showed significant changes on all of these variables from pre-MBSR to post-MBSR, and on all except the 2 anger variables from pre-test to 2-month follow-up, as well as significant reductions in rumination. Conclusion: An 8-week mindfulness training program might increase mindful awareness in daily life and have beneficial impact on clinically relevant emotion regulation processes.
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Keywords: mindfulness; emotion regulation; self-compassion; treatment outcome

Mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982, 1990) is a group-based intervention in which participants learn and practice various mindfulness practices, including sitting meditation, body scan meditation, hatha yoga, and loving-kindness or compassion meditation. Originally developed to treat patients suffering from chronic pain, it also has been demonstrated to reduce psychological distress and stress-related physical symptoms in patients with cancer and other medical illnesses, in nonclinical samples, and in two studies of psychiatric samples (Keng, Smoski, & Robins, 2011). Although the mechanisms through which the effects of MBSR on psychological symptoms such as depression, anxiety, and perceived stress are not yet well understood, changes in attitudes and behaviors related to emotion regulation, including reduced fear of and increased willingness to experience emotions rather than attempt to suppress them, and the development of more effective skills for regulating them, might be one set of mechanisms. The present study was designed to investigate the effects of the MBSR program on trait (daily experience) mindfulness and on several aspects of emotional experience and emotion regulation. Before presenting the study, we describe what we mean by mindfulness and summarize prior controlled studies of the effects of MBSR on emotion-related variables, highlighting the gaps in current knowledge that this study helps to address.

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Mindfulness

Mindfulness has been described as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn, 2003, p. 145). Mindfulness as a state can vary across time and situations within individuals, and there are also relatively stable individual differences in trait or dispositional mindfulness that have been shown to be related to psychological distress and adaptive functioning (Brown & Ryan, 2003).

In an attempt to operationalize mindfulness as a measurable psychological construct, Bishop et al. (2004) proposed that mindfulness incorporates two dimensions: self-regulation of attention and a particular orientation to experience. Self-regulation of attention involves nonelaborative observation and awareness of thoughts, sensations, and feelings from moment to moment. It entails the ability to sustain attention on an intended focus and the ability to switch attention to a new intended focus. Although all individuals are capable of such intentional direction of attention, much daily living occurs on "auto-pilot" or with less than full awareness. Some meditation practices are methods designed, in part, to develop these attention capacities. For example, one might practice sustaining attention on the breath. When the mind wanders from the breath, and the practitioner becomes aware of this, he or she might note to what content the mind has wandered, and then move attention back to the breath (or other intended focus). The second dimension of mindfulness—orientation to experience—concerns the attitude held towards one's present-moment experience, specifically one of curiosity, openness, and nonjudgment or acceptance of any sensations, thoughts, or feelings that arise.

One mechanism through which mindfulness practice might affect psychological symptoms and functioning is by creating a fundamental change in perspective on one's internal experience. Rather than getting caught up with the "internal chattering" of the mind or other contents of awareness, individuals who engage in mindfulness practice learn to observe their thoughts, emotions, and sensations in an objective and receptive manner, focusing on the *process* of awareness, rather than the *content* of awareness. Over time, individuals might develop greater insight into their habitual tendencies of thinking, which then allows them to alter negative patterns of thinking and/or react differently to them.

Effects of MBSR on Psychological Distress

MBSR has been shown to result in significant decreases on measures of general psychological distress or negative affect, and on more specific mood and emotion measures, including anxiety or worry, depression, and anger, in nonclinical samples (Anderson, Lau, Segal, & Bishop, 2007; Astin, 1997; Nyklíček & Kuipers, 2008; Shapiro, Astin, Bishop, & Cordova, 2005; Shapiro, Schwartz, & Bonner, 1998; Williams, Kolar, Reger, & Pearson, 2001), and in medical patients (Bränström, Kvillemo, Brandberg, & Moskowitz, 2010; Carmody et al., 2011; Gross et al., 2010; Grossman et al., 2010; Lengacher et al., 2009; Schmidt et al., 2011; Shapiro, Bootzin, Figueredo, Lopez, & Schwartz, 2003; Speca, Carlson, Goodey, & Angen, 2000; Weissbecker et al., 2002). Although MBSR was not developed specifically to treat individuals with psychiatric disorders, two recent studies suggest that the benefits demonstrated in nonclinical samples and medical patients might extend to individuals with diagnosed mood and anxiety disorders. Biegel, Brown, Shapiro, and Schubert (2009) reported significant effects of MBSR added to treatment-as-usual on anxiety and depression in depressed adolescents, and Vøllestad (in press) reported significant effects on several anxiety measures in patients with panic disorder, social anxiety disorder, or generalized anxiety disorder. Koszycki, Benger, Shlik, and Bradwejn (2007) also reported significant within-condition reductions on several measures of social anxiety and depression in adults with social anxiety disorder, but not greater than the control condition, which was standard group cognitive behavior therapy for social anxiety disorder. Although the present study focused on variables that are relevant for patients with mood, anxiety, and other psychiatric disorders, we examined the effects of MBSR in a nonclinical sample similar to the population for whom the MBSR program typically is provided.

Although these studies demonstrated promising findings with regard to the efficacy of MBSR in reducing psychological distress and enhancing psychological well being, little is known about the processes or mechanisms that lead to such clinical effects. It is possible that participation in MBSR and similar programs that involve daily mindfulness practice leads to increases in trait or dispositional mindfulness, and that such changes mediate the effects of MBSR on psychological distress and functioning. Highly experienced meditators have been found to score higher than nonmeditators on standardized measures of trait mindfulness (Lykins & Baer, 2009; Ortner, Kilner, & Zelazo, 2007), and several recent randomized controlled trials (RCTs) have reported that participation in MBSR led to significantly greater increases on standardized measures of mindfulness than a control condition (Anderson et al., 2007; Bränström et al., 2010; Gaylord et al., in press; Gayner et al., in press; Nyklíček & Kuipers, 2008; Schmidt et al., 2011; Shapiro, Oman, Thoresen, Plante, & Flinders, 2008). Only two of these RCTs (Bränström et al.; Gaylord et al.) used the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Kreitemeyer, & Toney, 2006) that we used in this study and now is frequently used in mindfulness research.

Increased mindfulness might also result in a reduction in cognitive failures due to inattention or absent-mindedness, such as misplacing one's keys and errors on simple tasks. Lykins and Baer (2009) reported that experienced meditators scored lower than nonmeditators on a self-report measure of such cognitive failures, but no RCTs of MBSR have yet examined effects on absent-mindedness or cognitive failures in daily life.

Improvements on anxiety, depression, anger, or other emotion measures following MBSR might reflect improved abilities in emotion regulation skills generally (Chambers, Gullone, & Allen, 2009), and specifically a greater ability or willingness to allow and be present with negative emotions rather than attempt to suppress or avoid them. Lykins and Baer (2009) found that meditation experience was associated with lower scores on a measure of difficulties in regulating emotions and on a measure of fear and avoidance of emotions, but neither of these constructs has been examined in an RCT of MBSR.

Specific Aims and Hypotheses

This study had several specific aims. The first was to test the hypothesis that participation in MBSR would result in participants bringing greater awareness to the experiences and activities of their daily lives, as reported on a standardized measure of trait mindfulness, the FFMQ (Baer et al., 2006). We also measured the converse of mindfulness, namely, absent-mindedness or cognitive failures, on simple everyday tasks.

A second aim was to test the hypothesis that MBSR would improve emotion regulation skills generally, using a standardized measure of difficulties regulating emotions, and more specifically that it would reduce both fear and avoidance of emotions, including suppression of anger, and over-engagement with emotion-related thoughts and behaviors, indexed by rumination, worry, and aggressive anger expression.

A third aim was to test the hypothesis that because mindfulness training emphasizes not judging experiences, including one's own thoughts, feelings, and behaviors, as intrinsically good or bad, participation in an MBSR program would increase self-compassion. Lykins and Baer (2009) found higher levels of self-compassion among experienced meditators than among controls, and one RCT has reported that MBSR increased self-compassion among healthcare providers (Shapiro et al., 2005), but this finding is in need of replication.

A fourth aim was to determine whether changes in the self-report outcome measures used in the study might be a result of the tendency to respond in socially desirable ways. Participant reports of improvements on outcomes could at least partly reflect demand characteristics of a treatment outcome study, such as the desire to please the investigators or to persuade oneself that his or her time and effort have been worthwhile. Although it is not a complete solution to that problem, assessing and, if necessary, controlling for individual differences in the tendency to respond in socially desirable ways addresses one potential limitation of self-report measures. To date, only one RCT of MBSR (Shapiro et al., 2008) and one of an abbreviated version of MBSR (Jain et al., 2007) have included a measure of socially desirable responding.

Finally, we examined whether any changes associated with MBSR were maintained over a 2-month follow-up period after the intervention. Based on previous RCTs of MBSR that included follow-up results (Biegel et al., 2009; Carlson, Ursuliak, Goodey, Angen, & Speca, 2001; Carmody et al., 2011; Gross et al., 2010; Grossman et al., 2010; Shapiro et al., 2008; Vøllestad, in press; Williams et al., 2001), we predicted that the effects observed would be largely maintained at 2-month follow-up.

Method

Participants and Procedure

Potential participants were recruited in two ways. Fliers were posted in the university hospital and on campus, and an e-mail was sent to former MBSR program participants, who were asked to refer individuals who had not taken the classes. Figure 1 shows the flow of participants through the phases of the trial. Eighty-one individuals responded and were screened by telephone to determine whether they met the following inclusion criteria: aged 18 years; no prior participation in an MBSR course; no regular meditation practice (or any other form of meditative practice, such as yoga or contemplative prayer) for more than an average of 20 minutes a week within the past 6 months; no current psychotic symptoms or suicidal ideation; no psychiatric hospitalizations within the past 6 months; able to attend MBSR classes at designated times; and willing to commit to daily home practice of mindfulness exercises. These criteria therefore do not select for a psychiatric or other clinical sample, but rather a relatively unselected sample of individuals interested in learning mindfulness practices as a means of reducing stress. Fifteen individuals declined participation, most because they could not take the classes at the designated times, four were ineligible because they had taken MBSR classes previously, and six withdrew before the time 1 assessment, leaving 56 who completed the time 1 assessment.1

Flow diagram of participant progress through the phases of the randomized trial.

Fifty-six individuals were recruited who met the above criteria. Their mean age was 46.25 years (standard deviation [*SD*] = 12.97; range = 21 to 87). The majority were female (84%) and Caucasian (91%). More than half (58%) were married, living with a partner or in an intimate relationship, and about half (51%) had a graduate degree. They were randomly

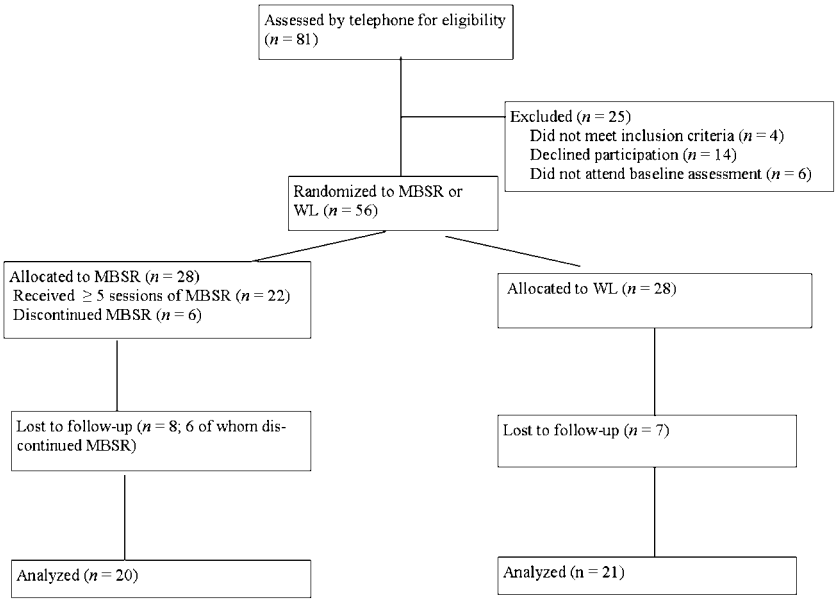

Figure 1. Flow diagram of participant progress through the phases of the randomized trial.

assigned to begin the MBSR program within the next 2 weeks (MBSR, $n = 28$) or to a waiting list (WL, $n = 28$) and completed baseline assessments before being informed of their experimental condition. MBSR participants were assessed at preintervention (time 1), postintervention (time 2), and at a 2-month follow-up (time 3). WL participants were assessed at the same three time periods, and received the MBSR program immediately after its completion by the initial MBSR group (i.e., between time 2 and time 3). The WL group also completed a 2-month follow-up evaluation, at time 4. At all assessment time points, participants filled out a packet of questionnaires that measured various aspects of psychological functioning. The initial assessment also included demographic information and previous experience with meditation, yoga, or contemplative practices. Participants were paid $10 for each assessment period. Twenty MBSR participants completed the program, defined as having attended at least five of the eight regular class meetings, and the time 2 (post-MBSR) assessment, and 21 WL participants completed the time 2 assessment.

Description of the Intervention

Modeled after Kabat-Zinn (1982), the MBSR program delivered in this study was the standard MBSR program that is conducted by staff of Duke Integrative Medicine numerous times per year. It comprises 8 weekly group classes of 2 1/2 hours per week. In addition, a daylong mindfulness retreat was offered between the sixth and seventh weeks. The director of the Duke MBSR program (JGB) was the primary course instructor. The program was delivered at no cost to all research participants. During the weekly classes, participants were taught several types of mindfulness practices, specifically awareness of breathing, mindful eating, body scan meditation, walking meditation, gentle yoga, choiceless awareness, loving-kindness meditation, and mindful speaking and listening. In addition to the formal mindfulness practices, there were didactic presentations and discussions on topics such as coping with stress and how to bring mindfulness into daily living. At the initial class, participants were each given a workbook and a set of six CDs, each with guided instructions for a specific type of mindfulness exercise. They were instructed to practice at home for 45 minutes per day, 6 days per week, with specific practices assigned for each week. Participants were encouraged to read Kabat-Zinn's (1990) "Full Catastrophe Living" as an additional resource.

Measures

The FFMQ (Baer et al., 2006) comprises 39 items rated on a 5-point Likert-type scale, ranging from 1 (*never or very rarely true*) to 5 (*very often or always true*) and provides a total score and subscores on five facets of mindfulness: observing (noticing/attending to sensations/perceptions/thoughts/feelings); describing (noting or labeling experiences with words); acting with awareness (rather than reacting automatically); nonjudging of experiences (not evaluating them as intrinsically good or bad); and nonreactivity to experiences (allowing thoughts and feelings to freely come and go). Higher scores indicate greater mindfulness. Baer et al. reported that internal consistencies of the subscales ranged between $\alpha = .75$ and .91, and Bränström et al. (2010) reported $\alpha = .93$ for the total score and between .83 and .95 for the subscales. No test-retest reliability data have been reported.

The Cognitive Failures Questionnaire (Broadbent, Cooper, Fitzgerald, & Parkes, 1982) is a 25-item scale that measures the tendency to make errors on simple, everyday tasks that individuals are usually capable of completing. Examples include forgetting appointments, failing to notice signposts on the road, and bumping into people. Items are scored on a 5-point Likert-type scale, ranging from 0 (*never*) to 4 (*always*), with higher scores indicating more cognitive failures. The measure has demonstrated good internal consistency ($\alpha = .91$) and test–retest reliability of $r = .82$ over a 2-month interval.

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) comprises 36 items rated on a 1–5 scale, with higher scores indicating greater difficulty in regulating emotions. It yields a total score and six subscale scores: Awareness (lack of awareness of

emotions); Clarity (lack of clarity about the specific emotion experienced); Nonacceptance (nonacceptance of negative emotions); Goals (inability to engage in goal-directed behavior when experiencing negative emotions); Impulses (difficulties controlling impulsive behaviors when experiencing negative emotions); and Strategies (limited access to emotion regulation strategies perceived as effective). Gratz and Roemer reported high internal consistency for the total score ($\alpha = .93$) and for each of the subscales (all $\alpha > .80$) among college students, good test–retest reliability over 4 to 8 weeks for the total score ($r = .88$), and moderate to good test-retest reliabilities for each of the subscales ($r = .57$ to .89) over 4 to 8 weeks.

The Affective Control Scale (Williams, Chambless, & Ahrens, 1997) is a 42-item self-report scale used to measure fear of the experience of emotions and fear of loss of control over internal and behavioral reactions to emotions. The questions are rated on a 7-point, Likert-type scale and yield a total score and four subscale scores: Anger, Depression, Anxiety, and Positive Emotions. Higher scores indicate greater fear of emotion. Williams et al. (1997) reported good internal consistency for the overall scale ($\alpha = .94$) and subscales ($\alpha = .72$ to .91), acceptable 2-week test-retest reliability for the overall scale ($r = .78$) and subscales ($r = .66$ to .77), and evidence of construct validity.

The Ruminative Responses Scale (Nolen-Hoeksema & Morrow, 1991) measures the tendency to engage in rumination, a passive and repetitive focus on one's negative emotions and other experiences. The scale comprises 22 items that are answered on a 4-point scale, ranging from 1 (*almost never*) to 4 (*almost always*), higher scores indicating more rumination. Treynor, Gonzalez, and Nolen-Hoeksema (2003) reported internal consistency of $\alpha = .90$ for the total score and one-year test-retest reliability of $r = .67$.

The Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990) is a 16-item self-report inventory designed to assess the generality, excessiveness, and uncontrollability of pathological worry. It yields one total score, with higher scores indicating more worry. Meyer et al. reported internal consistency of $\alpha = .93$, test–retest reliability of $r = .92$ over 8 to 10 weeks (Meyer et al.) and strong evidence of convergent and discriminant validity.

The Spielberger Anger Expression Scale (Spielberger et al., 1985) comprises 20 items rated on a 1–4 scale, ranging from 1 (*almost never*) to 4 (*almost always*). It yields two subscales: Anger-In (inhibition of the expression of anger) and Anger-Out (expression of anger as aggressive behavior). In a large community sample, the internal reliabilities for each of the subscales were .73 and .70, respectively (Knight, Chisholm, Pauling, & Waal-Manning, 1988).

The Self-Compassion Scale (Neff, 2003) assesses tendencies to be kind toward oneself in times of difficulty or pain, to be nonjudgmental about one's thoughts and feelings, and to see one's experience as a part of the larger human experience. This 26-item questionnaire comprises six subscales: Self-Kindness, Self-Judgment, Common Humanity, Isolation, Mindfulness, and Overidentification. All items are rated on a 5-point Likert-type scale, ranging from 1 (*almost never*) to 5 (*almost always*), with higher scores indicating greater self-compassion. Neff reported internal consistency of $\alpha = .92$ for the total score, test–retest reliabilities over 3 weeks of $r = .93$ for the total score and between .80 and .88 for the subscales, and good convergent and discriminant validity.

The Marlowe-Crowne Social Desirability Scale – Short Form C (Reynolds, 1982) comprises 13 items that are rated dichotomously as true or false. It provides a measure of individuals' tendencies to endorse socially desirable characteristics. Reynolds reported a correlation of .93 with the original 33-item version, and internal consistency of $r_{KR\text{-}20} = .76$, and Zook and Sipps (1985) reported test-retest reliability of.74 over a 6-week interval.

Statistical Analyses

All analyses were conducted using SPSS Version 16.0. Because of the relatively small sample size and the lack of interim assessments between preintervention and postintervention, we did not perform intent-to-treat analyses but instead included only participants who completed the study. Two-tailed independent samples *t* tests or chi-squared tests were first used to compare baseline characteristics of completers versus dropouts and of MBSR versus WL participants.

Potential covariates were examined from among nine baseline characteristics—gender, age, ethnicity, marital status, education, employment status, income, prior meditation experience, and social desirability—by evaluating whether each predicted change on any of the dependent measures in a series of hierarchical linear multiple regressions of postintervention scores on the corresponding preintervention scores and then on one of the potential covariates.

The primary analyses then evaluated the effects of group (MBSR vs. WL) on change in each of the dependent measures, in a series of hierarchical linear multiple regressions of postintervention scores on the corresponding preintervention scores and then on group. Because tests were conducted for a set of nine primary dependent variables, we maintained an overall family-wise error probability of less than .05 by using Holm's procedure (Holland and Copenhaver, 1988) to determine the significance criterion for each hypothesis tested. This procedure has greater power than the commonly used Bonferroni procedure. The same procedure was used for determining the significance of group effects on sets of subscales within several of the measures. Effect sizes of group as a predictor were estimated by f^2 (Cohen, 1988), for which values of .02, .15 and .35 are considered small, medium, and large, respectively.

After the randomized trial analyses, paired-samples t tests were used to examine preintervention and postintervention changes in the two groups combined (the initial MBSR group and the WL group after they too received the intervention), as well as the durability of change from preintervention to 2-month follow-up, again using Holm's procedure to determine significance in these sets of nine analyses. Effect sizes of these within-subjects analyses were estimated by d (Cohen), for which values of .20, .50, and .80 represent small, medium, and large effects, respectively.

Results

Differential Attrition

Six participants in the MBSR condition did not complete the program (attended fewer than five sessions) and two completed the program but did not complete the assessments at time 2. Seven WL participants did not complete the time 2 assessments. Completers and drop-outs did not differ significantly at preintervention on any of the dependent variables, either when compared within each condition or across both conditions combined.

Randomization Check

Table 1 shows the demographic and other baseline variables for each group of completers at preintervention. There were no significant differences between the MBSR and WL groups on any demographic variables, except that the MBSR group included a higher number of participants with some prior meditation, yoga, or contemplative practice experience, χ^2 $(1, N = 41) = 4.08$, $p = .04$. There were no group differences at preintervention on any of the dependent measures.

Correlations Among Dependent Measures

Correlations among the dependent measures at time 1 are shown in Table 2. Most were in the moderate range, with the highest being between the FFMQ total score and the Difficulties in Emotion Regulation Scale at $r = .77$, thus sharing 59% variance, not indicating redundancy among any of the measures.

Potential Covariates

To determine whether any demographic or other background variables (prior meditation experience and social desirability) predicted changes on any of the dependent measures, and therefore needed to be entered as covariates in the main analyses, we performed a series of hierarchical linear multiple regressions. Of 81 analyses (nine potential covariates and nine

Table 1
Sample Characteristics

Variable	Value	MBSR ($n = 20$)	WL ($n = 21$)
Gender	Female (%)	90.0	76.2
Age	Mean (Range)	43.8 (26–61)	46.5 (28–71)
Ethnicity	White (%)	95.0	85.7
	African American (%)	0	9.5
	Asian (%)	0	0
	Hispanic (%)	5.0	4.8
Marital status	Married, living with partner, or in intimate relationship (%)	60.0	71.4
	Separated, divorced, widowed (%)	20.0	19
	Never married (%)	20.0	9.5
Education	Some high school (%)	0	4.8
	Some college (%)	0	9.5
	College (%)	25.0	28.6
	Some graduate work (%)	10.0	9.5
	Graduate degree (%)	65.0	47.6
Employment status	Full-time (%)	70.0	76.2
	Part-time (%)	20.0	14.3
	Not employed (%)	10.0	9.5
Income	Less than $20,000 (%)	10.0	0
	$20,000–$65,000 (%)	50.0	66.7
	$65,000 and above (%)	45.0	33.3
Prior meditation or contemplative practice	Yes (%)	90.0	57.1

Note. MBSR = mindfulness-based stress reduction; WL = waiting list.

Table 2
Intercorrelations of Outcome Measures at Time 1 ($N = 41$)

Variable	CFQ	DERS	ACS	RRS	PSWQ	AX-IN	AX-OUT	SCS
FFMQ	−.63**	−.77**	−.70**	−.31*	−.61**	−.66**	0.08	.69**
CFQ		.51**	.52**	.36*	.47**	.45**	0.14	−.28
DERS			.76**	.50**	.57**	.55**	0.17	−.61**
ACS				.44**	.61**	.51**	−0.05	−.59**
RRS					.35*	.42**	0.14	−.51**
PSWQ						.46**	0.07	−.57**
AX_In			.				−0.17	−.60**
AX_Out								−.10

Note. FFMQ = Five Facet Mindfulness Questionnaire; CFQ = Cognitive Failures Questionnaire; DERS = Difficulties in Emotion Regulation Scale; ACS = Affective Control Scale; RRS = Ruminative Responses Scale; PSWQ = Penn State Worry Questionnaire; AX_In = Spielberger Anger Expression Scale – Anger-In; AX_Out = Spielberger Anger Expression Scale – Anger-Out; SCS = Self-Compassion Scale. $^{*}p < .05$. $^{**}p < .01$.

dependent measures), only four were significant at $p < .05$, which is an experiment-wise frequency not greater than would be expected by chance. Increases in mindfulness were associated with being employed ($p = .02$) and with non-Caucasian ethnicity ($p = .03$), decreases in absent-mindedness were associated with lower age ($p = .01$), and increases in self-compassion were associated with being employed ($p = .04$).

Group Differences in Change From Preintervention to Postintervention

Table 3 presents results of the hierarchical multiple regressions of the total scores on each outcome variable. For each outcome variable, the dependent or criterion variable was the postintervention score, the first step predictor was the preintervention score (creating residualized change scores), the second step (if any) was any covariates identified previously, and the final predictor was group. Group effects on residualized change scores indicated a significantly greater increase in mindfulness in the MBSR group and a significantly greater decrease in absent-mindedness, a significantly greater increase in self-compassion, and greater decreases in anger suppression, aggressive anger expression, fear of emotions, difficulties regulating emotions, and worry. There was a nonsignificant trend ($p = .06$) for a greater decrease in rumination in the MBSR group. Significant effects were mostly moderate in size, but were large for increased mindfulness and reduced anger suppression.

To explore the effects of MBSR on specific facets of mindfulness, while controlling for the shared variance among the facets, we conducted five hierarchical multiple regressions, in each of which the score on one of the FFMQ subscales at postintervention was the criterion variable. The first step of the regression entered the preintervention score on that subscale and on all of the other four subscales at preintervention, and the final step entered group. The MBSR group had significantly greater increases on all five FFMQ facets, even when controlling for the other four subscales and using the Holm procedure to set significance criterion levels to maintain a family-wise α of .05: observing, $\beta = .40$, $\Delta R^2 = .16$, $p < .001$; describing, $\beta = .36$, $\Delta R^2 = .12$, $p = .004$; acting with awareness, $\beta = .28$, $\Delta R^2 = .08$, $p = .01$; nonjudgment, $\beta = .33$, $\Delta R^2 = .11$, $p = .02$; and nonreactivity, $\beta = .43$, $\Delta R^2 = .19$, $p < .001$.

Parallel analyses to those conducted on subscales of the FFMQ were conducted on the DERS and Affective Control Scale subscales, such that effects on each subscale were examined when preintervention scores on the other subscales were controlled for. On the DERS, the MBSR group showed a significantly greater decrease on Strategies ($\beta = .40$, $\Delta R^2 = .16$, $p < .001$), and nonsignificant trends on Impulses ($\beta = .30$, $\Delta R^2 = .09$, $p = .02$) and Clarity ($\beta = .17$, $\Delta R^2 = .03$, $p = .08$). There were no group effects on change in Awareness, Nonacceptance, or Goals (all $p > .15$). Of the four Affective Control Scale subscales, the MBSR group showed significantly greater decreases in fear of Depression ($\beta = .31$, $\Delta R^2 = .10$,

Table 3
Mean (and SD) Values of MBSR and WL Groups at Time 1 and Time 2 and Test Statistics for the Effects of Group on Change in Outcome Variables

	Range at	MBSR ($n = 20$)		WL ($n = 21$)		Group Effect			
Outcome	Time 1	Time 1	Time 2	Time 1	Time 2	β	ΔR^2	p	f^2
FFMQ	77–166	121.6 (20.31)	138.35 (13.27)	125.10 (22.13)	125.76 (21.99)	.40	.16	.001	.47
CFQ	43–95	67.00 (9.24)	58.90 (9.41)	70.17 (13.13)	67.60 (10.27)	−.33	.11	.001	.31
DERS	53–135	89.66 (22.72)	72.00 (12.93)	82.89 (25.21)	83.38 (19.27)	−.30	.09	.009	.20
ACS	72–191	129.31 (35.08)	105.60 (26.28)	121.73 (38.20)	115.48 (30.99)	−.25	.06	.007	.22
RRS	22–75	49.90 (13.30)	47.10 (11.11)	49.62 (9.68)	50.90 (11.14)	−.18	.03	.062	.10
PSWQ	21–75	58.14 (13.96)	45.50 (14.53)	51.14 (15.63)	48.33 (15.15)	−.25	.06	.022	.27
AX_In	10–29	18.15 (4.26)	14.80 (3.19)	17.52 (5.30)	17.43 (4.11)	−.39	.15	.001	.36
AX_Out	8–28	12.45 (2.76)	11.55 (1.88)	15.33 (4.94)	15.71 (4.54)	−.28	.07	.005	.24
SCS	44–115	73.20 (17.58)	89.75 (15.38)	76.95 (19.53)	76.86 (20.60)	.36	.11	.006	.24

Note. MBSR = mindfulness-based stress reduction; WL = waiting list; FFMQ = Five Facet Mindfulness Questionnaire; CFQ = Cognitive Failures Questionnaire; DERS = Difficulties in Emotion Regulation Scale; ACS = Affective Control Scale; RRS = Ruminative Responses Scale; PSWQ = Penn State Worry Questionnaire; AX_In = Spielberger Anger Expression Scale – Anger-In; AX_Out = Spielberger Anger Expression Scale – Anger-Out; SCS = Self-Compassion Scale. Test statistics are for the last step of regression equations predicting time 2 scores, with time 1 scores and covariates entered at the first step and group assignment entered at the second step.

Table 4
Mean (and SD) Values at Preintervention, Postintervention, and Follow-Up for Combined Groups (N = 30)

Variable	Preintervention	Postintervention	2-month follow-up	Pre vs. post			Pre vs. follow-up		
				t	*p*	*d*	*t*	*p*	*d*
FFMQ	126.47 (21.40)	142.27 (13.17)	147.47 (15.66)	5.83	.001	.89	7.25	.001	1.12
CFQ	67.37 (11.39)	58.15 (8.50)	57.20 (10.18)	−5.80	.001	.92	−6.54	.001	.94
DERS	79.77 (15.88)	70.20 (11.59)	68.10 (16.38)	−4.50	.001	.69	−4.55	.001	.72
ACS	118.63 (28.31)	102.63 (27.38)	103.20 (30.08)	−5.07	.001	.57	−4.44	.001	.53
RRS	50.33 (12.86)	47.97 (13.26)	45.03 (11.42)	−1.50	.146	.18	−2.94	.006	.44
PSWQ	52.00 (14.73)	43.43 (13.94)	43.43 (15.94)	−3.91	.001	.60	−4.18	.001	.56
AX_In	17.20 (4.19)	14.97 (4.66)	16.30 (5.28)	−3.38	.002	.50	−2.24	.033	.19
AX_Out	13.57 (3.09)	12.53 (2.43)	13.00 (2.56)	−2.64	.013	.37	−1.19	.244	.20
SCS	78.07 (19.70)	92.03 (14.92)	93.93 (18.17)	5.00	.001	.80	4.80	.001	.84

Note. FFMQ = Five Facet Mindfulness Questionnaire; CFQ = Cognitive Failures Questionnaire; DERS = Difficulties in Emotion Regulation Scale; ACS = Affective Control Scale; RRS = Ruminative Responses Scale; PSWQ = Penn State Worry Questionnaire; AX_In = Spielberger Anger Expression Scale – Anger-In; AX_Out = Spielberger Anger Expression Scale – Anger-Out; SCS = Self-Compassion Scale.

$p = .002$) and Positive emotions ($\beta = .23$, $\Delta R^2 = .05$, $p = .02$), but not in fear of Anger or Anxiety (both $p > .15$).

Finally, among participants in the MBSR condition, we found no association between number of MBSR sessions attended (minimum five of eight required to be included in completer sample, mean = 7.30, $SD = .98$) and amount of change on any of the dependent variables (all $ps > .24$).

Replication in WL Group and 2-Month Follow-Up

Table 4 displays the descriptive statistics at preintervention, postintervention, and follow-up for the subset of participants from both groups combined who completed the assessments at all phases of the trial, including the 2-month follow-up ($n = 30$), and test statistics of the pairwise comparisons between preintervention and postintervention scores and between preintervention and follow-up. In dependent samples *t* tests, the combined sample showed significant preintervention to postintervention changes in expected directions on all dependent variables except for rumination. Effect sizes for mindfulness, absent-mindedness, and self-compassion were particularly large. Dependent samples *t* tests comparing preintervention and follow-up in the combined sample found significant changes similar to those at postintervention, with the following exceptions: suppression of anger and aggressive anger expression were no longer significantly decreased at follow-up, whereas rumination, which was not significant at postintervention, was significantly decreased at follow-up. Large effect sizes were observed again for mindfulness, absent-mindedness, and self-compassion.

Discussion

Compared with the WL condition, MBSR resulted in significantly greater reported increases in mindfulness and self-compassion and significantly greater decreases in absent-mindedness, difficulties regulating emotions, fear of emotions, worry, and both anger suppression and aggressive anger expression. Changes in rumination did not significantly differ between groups, but when the WL group also completed MBSR, the combined sample showed significant pre-test to follow-up changes on rumination also. These self-reported changes were not associated with social desirability response tendency, which increases our confidence in their validity.

Although Lykins and Baer (2009) reported that experienced meditators differed from controls on only four of the five FFMQ facets, not on acting with awareness, in our study, all five mindfulness facets showed a significant effect of the intervention, as they did in the only other randomized trial examining effects of MBSR on the FFMQ (Bränström et al., 2010). Taken together with studies showing effects of MBSR on a different measure of trait mindfulness (Nyklíček & Kuipers, 2008; Shapiro et al., 2008), there is growing evidence that a program of mindfulness training results in reported changes in mindfulness in daily life. Another indication that MBSR participants were more mindful during their daily lives is that they reported greater decreases in absent-minded behaviors, demonstrating for the first time a causal effect of MBSR participation on absent-mindedness that confirms the observational data of Lykins and Baer on experienced meditators. The MBSR program also emphasizes being compassionate toward one's self during mindfulness practices and at other times. Perhaps as a result, participants reported increases in self-compassion, as was reported by Shapiro et al. (2005).

Improvements in the ability to regulate emotions were also found to be associated with MBSR, in particular, in access to emotion regulation strategies. Participants might have viewed and used mindfulness practices as, among other things, emotion regulation strategies that could be employed in the context of strong emotions. Participants also might have learned that they could simply notice emotional states without doing anything to try to change them, which itself might have been viewed as a newly learned strategy for emotion regulation, or that treating one's emotional experience with greater self-compassion rather than judging the experience or one's self was another more accessible emotion regulation strategy.

Insofar as attempts to avoid emotions might impair the ability to regulate emotions, the reduction in difficulty regulating emotions also might be because of, in part, the corresponding decrease found in fear and avoidance of emotions, and specifically fears of depression and of positive emotions. It is not clear why we found no similar decreases in fear of anxiety or anger.

Perhaps as a result of improvements in strategies for regulating emotions and the ability to notice thoughts without getting caught up in them, we found that MBSR reduced reported worry, consistent with Anderson et al. (2007) and Shapiro et al. (1998). There also was a significant decrease in rumination at follow-up, but not immediately postintervention. Perhaps effects on rumination occur more gradually following a longer period of regular practice, though this is speculation, as we do not have reliable data on amount of practice.

Finally, although we found no effect on fear of anger, participants did report changes in how they experienced or expressed anger. MBSR led to significantly greater decreases in both anger suppression and aggressive anger expression. This is the first study to document an effect on these different dimensions of the experience and expression of anger, and to demonstrate that reductions in anger expression did not occur simply because participants were suppressing anger, but because of other mechanisms. It is possible that they might have learned to simply observe and accept their anger rather than acting on an urge to express it or try to get rid of it.

As we expected, almost all of the effects observed as a result of MBSR were maintained at 2-month follow-up. It is unclear to what extent the effects were maintained because participants continued to engage in mindfulness practice after the end of the intervention, or because the intervention itself has a long lasting effect that persists even without any postintervention home practice. Reductions in both anger suppression and anger expression showed signs of being less durable than changes observed in other variables. We do not know why those particular changes were less stable, but studies that include longer term follow-up are needed to provide valuable information about the durability of the range of changes associated with participation in an MBSR program.

This study found effects of MBSR on a number of variables, including increased mindfulness, increased self-compassion, reduced fear of emotions, and improved emotion regulation strategies, that might be mediators of its effects on psychological symptoms, such as anxiety, depression, and perceived stress, that have been documented in other randomized trials. A few randomized trials of MBSR have begun to test for such mediating effects, reporting a good fit for statistical models in which change in mindfulness mediated change in

perceived stress (Bränström et al., 2010; Nyklíček & Kuipers, 2008) and PTSD avoidance symptoms (Bränström et al.), but not change in positive or negative affect (Nyklíček & Kuipers), and change in self-compassion mediated change in perceived stress (Shapiro et al., 2005). However, these tests of mediation have included only changes in the proposed mediators and outcomes between the same two time points, from which it is impossible to determine whether or not change in the mediator temporally preceded change in the outcome. Randomized studies with data from multiple assessment points during the course of the intervention and follow-up will permit stronger conclusions regarding mediation. No studies of MBSR have yet reported such analyses.

The study had a number of strengths, including randomized assignment to MBSR or WL, a follow-up assessment, inclusion of measures of several constructs related to mindfulness or emotional functioning that have not previously been examined in studies of MBSR, such as absent-mindedness, difficulties regulating emotions, fear of emotions, anger suppression, and aggressive anger expression, and data analyses that controlled for potential demographic covariates and social desirability responding.

The study also had a number of limitations. One limitation is that all outcomes were assessed only by self-report. Changes on outcome measures were not related to a measure of socially desirable responding, which helps to rule out one potential source of bias, but participants' reports might have been influenced by demand characteristics of the study, such as the expectation that the investigators expected to see such changes only in the MBSR condition, or avoidance of the cognitive dissonance that would occur if they did not perceive themselves as having changed after expended effort on the program. Future studies would benefit from inclusion of assessment through behavioral observation and psychophysiological and other biological measures, in both naturalistic and laboratory task settings, as well as assessment of mindfulness and emotion regulation by self-report during daily life, such as through ecological momentary awareness methods.

Another limitation is that we did not examine whether observed changes were associated with the amount of mindfulness practice participants engaged in, because our data on homework completion were too incomplete for useful analyses. The MBSR group reported greater prior experience with meditation, yoga, or contemplative prayer than the WL group. The relatively high percentage of participants in both conditions who report such experience might be because of, in part, our liberal definition of prior meditation practice, which included forms of practice quite different from those taught in MBSR, such as contemplative prayer. However, we required that participants not have any recent regular practice. Most importantly, we examined whether this baseline variable was associated with change on any of our dependent variables, and it was not. It is therefore unlikely that group differences in prior meditation experience influenced our findings.

Another limitation is that we analyzed the data only for completers, rather than all participants randomized to condition, because of the relatively small sample and lack of interim data points, such that for dropouts, the last observation to carry forward as a proxy for post-test scores were their pre-test scores, which would result in very conservative analyses. Future studies should include a larger sample and at least one interim assessment and perform intent-to-treat analyses of treatment effects.

The sample had limited demographic range, being predominantly female, Caucasian, and highly educated. This has been true of most other studies of MBSR, and reflects the self-selected nature of the sample. It is not known to what extent the findings would generalize to participants with different demographic characteristics. Future studies should make efforts to recruit minority groups, men, and lower socioeconomic status participants. It should also be emphasized that this study was of a nonclinical sample. Although the variables studied appear to be relevant for individuals with mood, anxiety, and other disorders, the current findings cannot be assumed to generalize to such populations. Future studies of the effects of MBSR on emotion regulation in clinical samples are needed.

We compared MBSR to a no-treatment control group, rather than an active treatment or placebo condition. It is possible that the treatment group reported psychological improvements not because of the specific mindfulness trainings that they received in MBSR, but

because of nonspecific factors associated with being in an intervention of any kind or specifically a group intervention. A few recent studies have incorporated an active treatment comparator (Koszycki et al., 2007; Jain et al., 2007; Shapiro et al., 2008). Dismantling studies are also needed to better understand which components of this multicomponent program (e.g., didactic presentations and discussions about stress, coping, and mindful living, different mindfulness practices, and practicing in a group context) have the most effect on particular outcomes.

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