



Negative Cognitive Bias and Perceived Stress: Independent Mediators of the Relation Between Mindfulness and Emotional Distress

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Abstract

Although a growing body of research has demonstrated the benefits of mindfulness for depression and anxiety, the mechanisms by which mindfulness reduces emotional distress are unclear. At least two mechanisms have been proposed: reduced negative cognitive bias and stress reduction. Although both mechanisms have received initial support, these proposed mechanisms have not been examined concurrently. The present studies examined the extent to which less negative cognitive bias and less perceived stress uniquely accounted for the association between mindfulness and emotional distress. In two studies, participants completed measures of trait mindfulness, perceived stress, negative cognitive bias, depression, and anxiety. Across both studies, results from parallel multiple mediation models indicated that both negative cognitive bias and perceived stress accounted for unique variance in the mindfulness–emotional distress association. That is, greater mindfulness was related to less negative cognitive bias and less perceived stress, which in turn were associated with less emotional distress. The results suggest that both stress reduction and negative cognitive bias may be mechanisms by which mindfulness confers benefits to psychological well-being.

Keywords Mindfulness · Cognitive negative bias · Stress · Anxiety · Depression

A substantial body of literature has demonstrated that mindfulness is inversely related to emotional distress (e.g., Brown et al. 2007; Desrosiers et al. 2013). Specifically, greater trait mindfulness is associated with less depression and anxiety (e.g., Kiken and Shook 2012). Furthermore, a number of mindfulness-based clinical interventions, such as Mindfulness-Based Stress Reduction (Kabat-Zinn 1982) and Mindfulness-Based Cognitive Therapy (Segal et al. 2002), have been developed to decrease emotional distress. Several meta-analyses have demonstrated that these mindfulness-based interventions effectively reduce depression and anxiety (Hofmann et al. 2010; Khoury et al. 2015; Vøllestad et al. 2012). Thus, mindfulness seems to buffer against and reduce emotional distress. However, the specific mechanisms by which mindfulness lowers emotional distress have not been fully elucidated.

Some argue that mindfulness reduces the negatively biased cognitive patterns that characterize depression and anxiety (e.g., Kiken and Shook 2012). Cognitive theories of depression and anxiety maintain that maladaptive, negatively biased cognitive styles underlie symptoms of emotional distress (e.g., Beck 1987; Riskind 1997). For example, dysfunctional attitudes are a set of negative, rigid beliefs that involve unrealistic, perfectionistic standards for oneself (Beavers et al. 2007). Prospectively, dysfunctional attitudes predict first onset and recurrence of depression (Alloy et al. 2006). Similarly, rumination, or repeatedly focusing attention to one's emotional distress (Nolen-Hoeksema et al. 2008), is associated with more symptoms of emotional distress (e.g., Nolen-Hoeksema and Davis 1999). The looming vulnerability model of anxiety (Riskind 1997; Riskind and Williams 1999) posits that a tendency to view potentially threatening situations as rapidly escalating toward dreaded outcomes predisposes one to anxiety. This looming maladaptive style has been associated prospectively with increases in anxiety and worry (Riskind et al. 2000).

Because mindfulness promotes a nonjudgmental and accepting stance toward one's experiences (Bishop et al. 2004; Kabat-Zinn 1994), mindfulness may be related to less negative cognitive bias. Being mindful entails engaging with

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positive, negative, and neutral experiences equally, rather than avoiding or focusing on certain experiences more than others. By approaching one's experiences with a nonjudgmental stance, mindfulness is thought to help one view experiences with enhanced clarity and less bias (Brown et al. 2007; Shapiro et al. 2006).

Empirical evidence supports this proposition. Greater trait mindfulness is associated with less rumination (e.g., Brown and Ryan 2003; Kiken and Shook 2014), fewer depressogenic negative cognitions (Gilbert and Christopher 2010), and greater ability to let go of negative thoughts (Frewen et al. 2008). Furthermore, mindfulness-based interventions reduce negative cognitive bias. Mindfulness-Based Stress Reduction (Kabat-Zinn 1982) decreased dysfunctional attitudes, reduced the frequency of negative automatic thoughts, and increased the ability to let go of these negative thoughts (Frewen et al. 2008; Ramel et al. 2004). Together, these findings demonstrate that mindfulness is related to less negative cognitive bias.

Mediation models also support negative cognitive bias as a mechanism of action. Utilizing structural equation modeling, Kiken and Shook (2012) demonstrated that negative cognitive bias, operationalized as a latent variable consisting of dysfunctional attitudes, optimism, pessimism, and looming maladaptive style, partially mediated the inverse relation between trait mindfulness and emotional distress (i.e., depression and anxiety) in a non-clinical sample. Similarly, two systematic reviews found evidence that reduced rumination and worry following mindfulness-based interventions mediated the effects of the intervention on emotional distress (Gu et al. 2015; van der Velden et al. 2015). Thus, evidence supports negative cognitive bias as a mechanism through which mindfulness is related to less depression and anxiety.

However, mindfulness consists of multiple components (Baer 2003; Bishop et al. 2004; Brown et al. 2007). As such, multiple mechanisms likely explain the mindfulness–emotional distress association. One relatively new account of mindfulness offers stress reduction as a mechanism through which mindfulness produces health benefits (Creswell and Lindsay 2014). Although the finding that mindfulness reduces stress is well documented (e.g., Bishop 2002), the notion that less stress is a mechanism through which mindfulness produces health benefits is new. Specifically, Creswell and Lindsay (2014) argue that by encouraging a nonjudgmental, accepting perspective to one's experiences, mindfulness mitigates stress appraisals and physiological stress responses, which in turn explain why mindfulness is related to better health.

According to stress-diathesis models of depression and anxiety, the interaction of stressful life events and predispositions to emotional distress predict the onset of depression and anxiety (e.g., Finlay-Jones and Brown 1981; Metalsky and Joiner 1992). Using this framework, the effectiveness of

mindfulness in reducing depression and anxiety may stem from mindfulness aiding individuals in coping with stressful life events. That is, by fostering a nonjudgmental perspective toward one's experiences, mindfulness may reduce reactivity to stressful events. In turn and in line with stress-diathesis models, less reactivity to stress may protect against depression and anxiety.

There is a wealth of evidence demonstrating that mindfulness-based interventions reduce self-reported levels of stress (e.g., Chiesa and Serretti 2009; Shapiro et al. 2005). Mindfulness is also related to activity levels in the amygdala, a region of the brain involved in initiating the stress response and in the processing of emotional information. Greater trait mindfulness is associated with less resting activity in the bilateral amygdala (Way et al. 2010) and less gray matter in the right amygdala (Taren et al. 2013), which are neurological patterns associated with less stress (Hölzel et al. 2009). Furthermore, a 3-day mindfulness training intervention reduced connectivity between the right amygdala and the anterior cingulate cortex, which suggests lower stress (Taren et al. 2014).

Mindfulness-based interventions may also alter the peripheral stress response, but these findings are somewhat mixed. Trait mindfulness has been related to lower cortisol reactivity in participants exposed to a high stress situation (Brown et al. 2012). Furthermore, participants who underwent Mindfulness-Based Stress Reduction exhibited significantly reduced resting blood pressure from pre-intervention to post-intervention and smaller increases in blood pressure in response to a stressor as compared to a waitlist control group (Nyklíček et al. 2013). Similarly, self-reported stress reactivity in the face of a stressor was lower for participants who underwent a brief mindfulness intervention than participants in an analytic cognitive training control group (Creswell et al. 2014). However, the stress-buffering effects on blood pressure were not replicated in this study. Furthermore, salivary cortisol reactivity to a stressor task was higher in the mindfulness group than the control group. Based on evidence from imaging, physiological, and self-report studies, there is some support for the stress reduction hypothesis. However, this proposed mechanism is relatively new, and there is limited research examining the extent to which stress reduction explains the health benefits of mindfulness, particularly with regard to emotional distress.

In sum, there is relatively strong evidence that indicates negative cognitive bias as a mechanism through which mindfulness is associated with less emotional distress. However, as mindfulness is a multi-faceted construct, it is unlikely that mindfulness confers benefits through a single mechanism. Furthermore, in one study, negative cognitive bias partially mediated the association between mindfulness and emotional distress (Kiken and Shook 2012), which suggests other mechanisms are also at work. More recently, Creswell and Lindsay

(2014) proposed a stress reduction account of mindfulness. Although there is some preliminary evidence to support stress reduction as a mechanism of mindfulness, it remains unclear whether the stress reduction account of mindfulness explains unique variance in the mindfulness–emotional distress relation. The purpose of this research was to examine whether lower levels of perceived stress and negative cognitive bias are unique mechanisms through which trait mindfulness is related to less emotional distress. Given evidence supporting reduced stress and reduced cognitive negative bias, it was hypothesized that less perceived stress and less negative cognitive bias would independently mediate the relation between trait mindfulness and emotional distress.

Study 1

The goal of study 1 was to initially examine the relations among mindfulness, perceived stress, negative cognitive bias, depression, and anxiety. Critically, we assessed whether negative cognitive bias and perceived stress were two unique mechanisms through which mindfulness is related to less depression and anxiety.

Method

Participants

A total of 156 undergraduate psychology students (75.6% female; 82.7% White; $M_{\text{age}} = 19.10$ years, $SD = 1.30$) at West Virginia University were recruited. To participate, students had to be 18 years or older and fluent in English language. Sample size was based on an a priori power analysis. Fritz and MacKinnon (2007) recommend a sample size of 148 for a simple mediation model using bias-corrected bootstrapping, assuming small to moderate effect sizes between the X and M variables and the M and Y variables. Furthermore, a power analysis using G Power (Faul et al. 2009) revealed a necessary sample size of 141 to detect a small-medium effect in a multiple regression model testing for significant R^2 increase with two tested predictors and three total predictors, assuming power is .80 and $\alpha = .05$.

Procedure

The study was part of a larger project examining individual differences in eye-gaze patterns. Upon arriving at the lab, the experimenter provided participants with an overview of the study and participants provided informed consent. Participants then completed a 15-min eye-tracking task that was unrelated to the purpose of the present study. Next, participants completed a series of questionnaires that included the

primary measures of interest in a fixed order. All questionnaires were completed on a computer using MediaLab (Jarvis 2010).

Measures

Mindful Attention Awareness Scale (MAAS; Brown and Ryan 2003) This is a 15-item, unidimensional measure of trait mindfulness (α s range from .80 to .87). Participants indicate how frequently they experience each item (e.g., I do jobs or tasks automatically, without being aware of what I'm doing) on a scale from 1 ("almost always") to 6 ("almost never"). All items are reverse coded and then averaged to compute a total scale. Higher total scores indicate higher levels of trait mindfulness. The MAAS is directly associated with openness to experience, internal state awareness, and need for cognition (Brown and Ryan 2003). It is also indirectly associated with BDI-II and rumination (Brown and Ryan 2003). Furthermore, MAAS scores are higher in those with meditation experience, relative to individuals with no meditation experience (e.g., Vinchurkar et al. 2014).

Cognitive and Affective Mindfulness Scale-Revised (CAMS-R; Feldman et al. 2007) This 12-item scale is a unidimensional measure of trait mindfulness (α s range from .74 to .77). Participants indicate how frequently they experience each item (e.g., "It is easy for me to concentrate on what I am doing.") on a scale from 1 ("rarely/not at all") to 4 ("almost always"). The appropriate items are reverse scored and then items are averaged to compute a total scale score. Higher total scores indicate greater levels of trait mindfulness. The CAMS-R is positively correlated with the MAAS and negatively correlated with depression and anxiety (Feldman et al. 2007).

Beck Depression Inventory (BDI-II; Beck et al. 1996) To assess depressive symptoms, the BDI-II was used and served as an indicator of emotional distress ($\alpha = .93$). This is a 21-item, unidimensional self-report scale that measures depression severity. For each item, participants indicate the statement that best describes the way they have felt during the past 2 weeks. An example item asks participants to describe how often they felt sadness. Participants choose either 0 ("I do not feel sad"), 1 ("I feel sad much of the time"), 2 ("I am sad all of the time"), or 3 ("I am so sad or unhappy that I can't stand it"). Items are summed to compute a total scale score, with higher numbers indicating greater depression. The BDI-II is highly related to the Hamilton Depression Rating Scale, demonstrating convergent validity (Beck et al. 1996). It also showed a 1-week test-retest reliability with a correlation coefficient of .93 (Beck et al. 1996).

Beck Anxiety Inventory (BAI; Beck et al. 1988) To assess anxiety symptoms, the BAI was used and also served as an indicator of emotional distress ($\alpha = .88$). The BAI is a 21-item,

unidimensional self-report scale that measures trait anxiety. Participants indicate how much they are bothered by common symptoms of anxiety (e.g., unable to relax, difficulty in breathing) on a scale from 0 (“not at all”) to 3 (“severely”). Items are summed to create a total scale, with higher numbers indicating greater anxiety. The BAI demonstrated a moderate association with the Hamilton Anxiety Rating Scale Revised and a small correlation with the Hamilton Depression Rating Scale, demonstrating convergent and discriminant validity, respectively (Beck et al. 1988).

Ruminative Response Scale (RRS; Treynor et al. 2003) This measure assessed participants’ tendency to ruminate. The RRS is a 10-item scale that consists of two subscales: reflection (RRS-R; $\alpha = .72$) and brooding (RRS-B; $\alpha = .77$). The reflection subscale (e.g., “Go away by yourself and think about why you feel this way.”) refers to neutrally valenced remembrance of past events, whereas the brooding subscale (e.g., “Think about a recent situation, wishing it had gone better.”) refers to anxiously or moodily pondering the past. Participants indicate the frequency with which they engage in various behaviors on a scale from 1 (“almost never”) to 4 (“almost always”). As the reflection subscale assesses rumination about neutrally valenced events, only the brooding subscale was used as an indicator of negative cognitive bias. Items on each subscale are summed to compute a total subscale score. Higher total scores indicate more reflection or brooding. The test-retest correlation for the brooding subscale is .77, and the test-retest correlation for the reflection subscale is .60 over 1 year. Both subscales are directly associated with measures of depression and psychological strain, but the brooding subscale is more strongly correlated with depression and strain than the reflection subscale (Treynor et al. 2003).

Dysfunctional Attitudes Scale-Short Form 1 (DAS; Beevers et al. 2007) Like the RRS-B, the DAS was used as an indicator of negative cognitive bias. The DAS is a 9-item scale measuring cognitive distortions related to depression ($\alpha = .84$). Participants indicated how well each statement describes how they generally feel (e.g., “If I fail at my work, then I am a failure as a person”) on a scale from 1 (“totally agree”) to 4 (“totally disagree”). All items on the scale are reverse scored and then summed to compute a total score. Higher total scores indicate more dysfunctional attitudes. The DAS is directly related to other measures of cognitive bias, depression, and hopelessness (Beevers et al. 2007).

Perceived Stress Scale (PSS; Cohen et al. 1983) This is a 14-item, unidimensional self-report measure of an individual’s perceptions of stress (α s range from .84 to .86). Participants indicated how often they have felt certain ways (e.g., “In the past month, how often have you felt nervous or stressed?”) in the past month on a scale from 0 (“never”) to 4 (“very often”).

Items are summed to compute a total score. Higher scores indicate higher levels of perceived stress. The PSS is strongly correlated with other measures of stress and is moderately to strongly correlated with measures of depression and anxiety (Lee 2012).

Demographic Questionnaire Participants were asked about common demographic variables including age, gender, and ethnicity.

Data Analyses

To test whether perceived stress and negative cognitive bias mediated the relation between mindfulness and emotional distress, a parallel multiple mediation analysis using 5000 bootstrapped samples with the PROCESS macro (Preacher and Hayes 2004) was conducted. A parallel multiple mediator model tests a model whereby a predictor variable influences an outcome variable through two or more mediators with the assumption that the mediators do not causally influence one another (Hayes 2013). Thus, the reported parallel multiple mediation model tested whether trait mindfulness was inversely related to emotional distress through both less negative cognitive bias and less perceived stress, assuming that negative cognitive bias and perceived stress are not causally related.

It may not be appropriate to assume that perceived stress and negative cognitive bias are independent, particularly given the correlation between the two constructs (see Tables 1 and 2). As such, a serial multiple mediation model was also tested. A serial multiple mediation model tests the direct and indirect effects of a predictor variable (X) on an outcome variable (Y) through two mediators (M_1, M_2) where X causes M_1 , M_1 causes M_2 , and M_2 causes Y (Hayes 2013). Whereas the parallel multiple mediation model assumed no casual relation between the two mediators, the serial multiple mediation model assumes that one mediator causes another mediator. Creswell and Lindsay (2014) speculated that by encouraging a nonjudgmental perspective toward one’s experiences, mindfulness may mitigate initial threat appraisals which in turn reduce stress. That is, changes in negative cognitive bias might precede and cause reductions in stress. To test whether trait mindfulness reduces negative cognitive bias which in turn decreases perceived stress, subsequently lowering emotional distress, a serial multiple mediation analysis using 5000 bootstrapped samples with the PROCESS macro (Preacher and Hayes 2004) was also conducted.

To determine the relative magnitude of the indirect effects in both the parallel and serial mediation models, contrasts were created. Significant contrasts indicate that the size of indirect effects differs. Indirect effects and contrasts were considered statistically significant when the 95% bias-corrected confidence interval did not include zero.

Table 1 Mean, standard deviation, Cronbach's alpha, and correlations for all variables in study 1

	1	2	3	4	5	6	7.	8.
1. MAAS	–	–	–	–	–	–	–	–
2. CAMS-R	.50**	–	–	–	–	–	–	–
3. DAS	–.30**	–.25**	–	–	–	–	–	–
4. RRS-B	–.41**	–.31**	.25**	–	–	–	–	–
5. RRS-R	–.34**	–.16*	.20*	.50**	–	–	–	–
6. PSS	–.40**	–.56**	.33**	.59**	.32**	–	–	–
7. BAI	–.33**	–.20*	.15†	.55*	.28**	.46**	–	–
8. BDI	–.45**	–.45**	.38**	.69**	.43**	.68**	.48**	–
Mean	3.75	2.55	19.37	9.51	7.91	26.44	12.21	10.43
SD	.87	.55	4.51	3.16	2.85	7.39	9.82	7.31
α	.89	.82	.81	.76	.76	.84	.92	.88

MAAS Mindful Attention Awareness Scale, CAMS-R Cognitive and Affective Mindfulness Scale-Revised, DAS Dysfunctional Attitudes Scale, RRS-R Ruminative Response Scale Reflection subscale, RRS-B Ruminative Response Scale Brooding Subscale, PSS Perceived Stress Scale, BDI Beck Depression Inventory-II, BAI Beck Anxiety Inventory

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

Because there were multiple measures of mindfulness, negative cognitive bias, and emotional distress, composite variables were created to simplify the analyses and presentation of the findings (e.g., Shook et al. 2017). The mindfulness composite consisted of the MAAS and CAMS-R; the negative cognitive bias composite consisted of the DAS and RRS-R; and the emotional distress composite consisted of the BDI and BAI. RRS-R was not included in the negative cognitive bias composite because it refers to neutral remembrance of past events and is more weakly associated with emotional distress than the RRS-B (Treyner et al. 2003). To create the composite variables, scores for each measure were standardized and averaged together. Mediation analyses were conducted with the

individual measures of mindfulness and emotional distress, but the pattern of results did not significantly differ from the analyses utilizing the composite variables.

Results

Descriptive statistics and Cronbach's alpha for each measure, as well as correlations among all measures, are presented in Table 1. The measures of mindfulness (MAAS and CAMS-R) were positively associated. All measures of negative cognitive bias (DAS and RRS-B) were positively associated. The measures of emotional distress (BDI and BAI) were positively

Table 2 Mean, standard deviation, Cronbach's alpha, and correlations for all variables in study 2

	1	2	3	4	5	6	7.	8.	9.
1. MAAS	–	–	–	–	–	–	–	–	–
2. CAMS-R	.42**	–	–	–	–	–	–	–	–
3. DAS	–.41**	–.42**	–	–	–	–	–	–	–
4. RRS-B	–.35**	–.43**	.39**	–	–	–	–	–	–
5. RRS-R	–.31**	–.26**	.27**	.75**	–	–	–	–	–
6. LMSQ	–.22**	–.36**	.28**	.38**	.24**	–	–	–	–
7. PSS	–.34**	–.65**	.44**	.56**	.38**	.34**	–	–	–
8. BAI	–.32**	–.43**	.38**	.48**	.50**	.30**	.45**	–	–
9. BDI	–.39**	–.56**	.45**	.60**	.52**	.33**	.66**	.58**	–
Mean	3.56	2.57	19.35	11.15	10.08	54.43	28.11	17.00	13.30
SD	.88	.55	5.09	4.03	3.80	11.84	7.74	13.57	11.11
α	.90	.78	.85	.86	.83	.85	.81	.95	.93

MAAS Mindful Attention Awareness Scale, CAMS-R Cognitive and Affective Mindfulness Scale-Revised, DAS Dysfunctional Attitudes Scale, RRS-R Ruminative Response Scale Reflection subscale, RRS-B Ruminative Response Scale Brooding Subscale, LMSQ Looming Maladaptive Style Questionnaire, PSS Perceived Stress Scale, BDI Beck Depression Inventory-II, BAI Beck Anxiety Inventory

* $p < .05$; ** $p < .01$

associated. Both measures of emotional distress were positively correlated with PSS and most measures of negative cognitive bias. BAI was not significantly associated with DAS. Generally, individuals with higher levels of anxiety and depression tended to report higher levels of perceived stress and negative cognitive bias. Additionally, both measures of emotional distress were inversely correlated with both measures of mindfulness. That is, higher levels of trait mindfulness were associated with lower levels of anxiety and depression. The mindfulness measures were also inversely associated with PSS and both measures of negative cognitive bias. Individuals higher in trait mindfulness tended to report less perceived stress and less negative cognitive bias. The negative cognitive bias measures were positively related to PSS.

Parallel Multiple Mediation Model

A parallel multiple mediation model tested whether greater trait mindfulness was related to less emotional distress through less negative cognitive bias and less perceived stress (see Fig. 1). Trait mindfulness was a significant predictor of negative cognitive bias ($b = -.40$, $t(154) = 6.41$, $p < .001$), perceived stress ($b = -4.36$, $t(154) = -7.82$, $p < .001$), and emotional distress ($b = -.45$, $t(154) = -6.93$, $p < .001$). Individuals higher in mindfulness reported less negative cognitive bias, perceived stress, and emotional distress. When trait mindfulness, negative cognitive bias, and perceived stress were entered simultaneously as predictors of emotional distress, negative cognitive bias ($b = .40$, $t(152) = 5.46$, $p < .001$) and perceived stress ($b = .04$, $t(152) = 5.48$, $p < .001$) were significant predictors of emotional distress. The association between trait mindfulness and emotional distress became non-significant ($b = -.10$, $t(152) = -1.65$, $p = .10$). With negative cognitive bias, perceived stress, and trait mindfulness entered as predictors, the model as a whole significantly predicted emotional

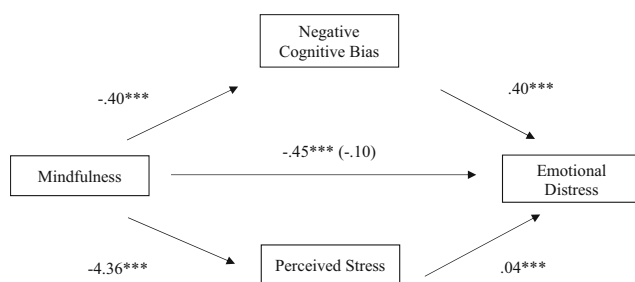


Fig. 1 Negative cognitive bias and perceived stress as parallel mediators in the association between mindfulness and emotional distress in study 1. All pathways presented are unstandardized regression coefficients. The mean estimate of the indirect effect of mindfulness on emotional distress through perceived stress was $-.19$ ($SE = .04$), with a 95% bias-corrected confidence interval of $[-.28, -.13]$. The mean estimate of the indirect effect of mindfulness on emotional distress through negative cognitive bias was $-.16$ ($SE = .05$), with a 95% bias-corrected confidence interval of $[-.26, -.08]$. * $p < .05$; ** $p < .01$; *** $p < .001$

distress, $R^2 = .55$, $F(3, 152) = 63.07$, $p < .001$. Both indirect effects were significant. The mean estimate of the indirect effect of trait mindfulness on emotional distress through perceived stress was $-.19$ ($SE = .04$), with a 95% bias-corrected confidence interval of $[-.28, -.13]$. The mean estimate of the indirect effect of trait mindfulness on emotional distress through negative cognitive bias was $-.16$ ($SE = .05$), with a 95% bias-corrected confidence interval of $[-.26, -.08]$. The mean contrast variable was $.04$ ($SE = .06$), with a 95% confidence interval of $[-.09, .15]$, indicating that the magnitude of the indirect effect of trait mindfulness on emotional distress through perceived stress did not differ from the indirect effect through negative cognitive bias. Thus, both perceived stress and negative cognitive bias mediated the relation between trait mindfulness and emotional distress.

Serial Multiple Mediation Model

To test whether trait mindfulness reduces negative cognitive bias which in turn decreases perceived stress, subsequently lowering emotional distress, a serial multiple mediation analysis was conducted. The mean estimate of the indirect effect of trait mindfulness on emotional distress through perceived stress, controlling for negative cognitive bias, was $-.12$ ($SE = .03$), with a 95% bias-corrected confidence interval of $[-.19, -.07]$. The mean estimate of the indirect effect of trait mindfulness on emotional distress through negative cognitive bias, controlling for perceived stress, was $-.15$ ($SE = .05$), with a 95% bias-corrected confidence interval of $[-.26, -.08]$. Both indirect effects were statistically significant, indicating that perceived stress and negative cognitive bias independently mediated the relation between trait mindfulness and emotional distress. The mean estimate of the indirect effect of trait mindfulness on emotional distress in which negative cognitive bias casually influences perceived stress was $-.07$ ($SE = .02$), with a 95% bias-corrected confidence interval of $[-.11, -.04]$, suggesting serial mediation. However, contrast analyses revealed that the unique indirect effect through negative cognitive bias was larger than the serial indirect effect (mean estimate = $-.09$, $SE = .04$; 95% CI $[-.19, -.01]$), but did not differ from the indirect effects through perceived stress (mean estimate = $-.04$, $SE = .06$; 95% CI $[-.16, .08]$). The indirect effect through perceived stress did not differ from the serial indirect effect (mean estimate = $-.05$, $SE = .03$; 95% CI $[-.02, .12]$).

Discussion

We tested the hypothesis that perceived stress and negative cognitive bias would be unique mediators using two data analytic techniques: one technique that assumed negative cognitive bias and perceived stress were not casually related and

one that assumed negative cognitive bias caused perceived stress. Across both data analytic techniques, we found that negative cognitive bias and perceived stress independently mediated the relation between trait mindfulness and emotional distress. Also, the magnitude of the indirect effect of mindfulness on emotional distress through perceived stress did not differ from the magnitude of the indirect effect of mindfulness on emotional distress through negative cognitive bias. Although the indirect effect through perceived stress did not differ in magnitude from the serial indirect effects, it is noteworthy that the indirect effect through negative cognitive bias was larger than the serial indirect effect. Despite the promising findings, there were some notable limitations to study 1. First, participants completed the measures in a fixed order, which may have influenced the results. Second, participants underwent an image viewing task before completing the measures. Although the image viewing task tested a separate set of hypotheses unrelated to the present study, it is possible that the task influenced responding on the measures.

Study 2

The purpose of study 2 was to replicate the finding that negative cognitive bias and perceived stress are independent mediators of the relation between trait mindfulness and emotion distress while addressing the limitations of study 1. Specifically, the questionnaires in study 2 were presented in a random order so as to eliminate potential order effects influencing the pattern of results. Second, participants did not complete an image viewing task. Also, to assess negative cognitive bias more broadly, study 2 included an additional measure: looming maladaptive cognitive style. It was predicted that less negative cognitive bias and less perceived stress would independently explain the association between trait mindfulness and emotional distress.

Method

Participants

A total of 342 undergraduate psychology students (77.8% female; 86.3% White; $M_{\text{age}} = 19.60$ years, $SD = 1.71$) at West Virginia University were recruited. To participate, students had to be 18 years or older and fluent in English language. Because the size of the indirect effects determined in study 1 was relatively small, a larger sample size was recruited to ensure adequate power. A power analysis using G Power (Faul et al. 2009) revealed a necessary sample size of 325 to detect a small effect in a multiple regression model testing for significant R^2 increase with two tested predictors and three total predictors, assuming power is .80 and $\alpha = .05$.

Procedure

The study was conducted online via SurveyMonkey (<https://www.surveymonkey.com/>). After agreeing to participate via an online consent form, participants completed the questionnaires in a random order, except for the demographic questions which appeared last.

Measures

Participants completed the same measures as described in study 1. This included the CAMS-R, MAAS, BDI, BAI, RRS, DAS, PSS, and demographic questions. Participants also completed another measure of negative cognitive bias.

Looming Maladaptive Style Questionnaire (LMSQ; Riskind et al. 2000) The LMSQ measures the degree to which one engages in this cognitive style and served as an additional indicator of negative cognitive bias ($\alpha = .91$). The LMSQ presents participants with six vignettes that depict potentially troubling scenarios (e.g., “You develop heart palpitations while talking to someone about a financial problem.”). After being presented with each scenario, on a 5-point Likert-type scale, participants indicate whether the chances of having difficulty are decreasing or expanding, whether level of threat is constant or growing rapidly, and whether they envision this problem becoming progressively worse. Across the six vignettes, responses for each of these three questions were summed to create a total score such that higher scores indicate higher levels of looming maladaptive cognitive style. In validation studies, the LMSQ was associated with other measures of anxiety, worry, and depression.

Data Analyses

The data analytic approach in study 2 was the same as that used in study 1. The only difference was that the LMSQ was included in the negative cognitive bias composite variable.

Results

Descriptive statistics and Cronbach’s alpha for each measure, as well as correlations among all measures, are presented in Table 2. The measures of trait mindfulness (MAAS and CAMS-R) were positively associated. All measures of negative cognitive bias (DAS, RRS-B, and LMSQ) were positively associated. The measures of emotional distress (BDI and BAI) were positively associated. Both measures of emotional distress were positively correlated with PSS and all of the negative cognitive bias measures. That is, individuals with higher levels of depression and anxiety tended to also report higher levels of perceived stress and higher levels of negative

cognitive bias. Both measures of emotional distress were inversely correlated with both measures of trait mindfulness. The trait mindfulness measures were inversely associated with PSS and all measures of negative cognitive bias. In other words, higher levels of mindfulness were associated with lower levels of emotional distress, negative cognitive bias, and perceived stress. The negative cognitive bias measures were positively related to PSS. Individuals who reported more negative cognitive bias tended to report more perceived stress.

Parallel Multiple Mediation Model

As in study 1, a parallel mediation model was tested to determine whether perceived stress and negative biased cognition independently mediated the relation between trait mindfulness and emotional distress (see Fig. 2). Trait mindfulness was a significant predictor of negative cognitive bias ($b = -.24$, $t(340) = 12.26$, $p < .001$), perceived stress ($b = -2.67$, $t(340) = -13.37$, $p < .001$), and emotional distress ($b = -.29$, $t(340) = -12.13$, $p < .001$). That is, individuals higher in trait mindfulness reported less negative cognitive bias, perceived stress, and emotional distress. When trait mindfulness, negative cognitive bias, and perceived stress were entered simultaneously as predictors of emotional distress, both negative cognitive bias ($b = .52$, $t(340) = 8.84$, $p < .001$) and perceived stress ($b = .03$, $t(340) = 5.51$, $p < .001$) were significant predictors of emotional distress. The association between trait mindfulness and emotional distress was still significant, but reduced in strength ($b = -.08$, $t(340) = -3.18$, $p = .002$). With negative cognitive bias, perceived stress, and trait mindfulness entered as predictors, the model as a whole significantly predicted emotional distress, $R^2 = .53$, $F(3, 338) = 130.54$, $p < .001$. Both indirect effects were statistically significant. The mean estimate of the indirect effect of trait mindfulness on emotional distress through perceived stress was $-.08$

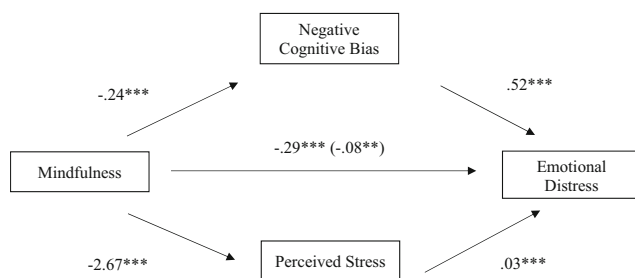


Fig. 2 Negative cognitive bias and perceived stress as parallel mediators in the association between mindfulness and emotional distress in study 2. All pathways presented are unstandardized regression coefficients. The mean estimate of the indirect effect of mindfulness on emotional distress through perceived stress was $-.08$ ($SE = .02$), with a 95% bias-corrected confidence interval of $[-.12, -.05]$. The mean estimate of the indirect effect of mindfulness on emotional distress through negative cognitive bias was $-.13$ ($SE = .02$), with a 95% bias-corrected confidence interval of $[-.17, -.09]$. * $p < .05$; ** $p < .01$; *** $p < .001$

($SE = .02$), with a 95% bias-corrected confidence interval of $[-.12, -.05]$. The mean estimate of the indirect effect of trait mindfulness on emotional distress through negative cognitive bias was $-.13$ ($SE = .02$), with a 95% bias-corrected confidence interval of $[-.17, -.09]$. The mean contrast effect was $.04$ ($SE = .03$), with a 95% confidence interval of $[-.10, .02]$, indicating that the magnitude of the indirect effect of trait mindfulness on emotional distress through perceived stress and negative cognitive bias did not differ. Thus, both perceived stress and negative cognitive bias mediated the relation between trait mindfulness and emotional distress.

Serial Multiple Mediation Model

To test whether trait mindfulness reduces negative cognitive bias which in turn decreases perceived stress, subsequently lowering emotional distress, a serial multiple mediation analysis was conducted. The mean estimate of the indirect effect of trait mindfulness on emotional distress through perceived stress, controlling for negative cognitive bias, was $-.06$ ($SE = .01$), with a 95% bias-corrected confidence interval of $[-.09, -.04]$. The mean estimate of the indirect effect of trait mindfulness on emotional distress through negative cognitive bias, controlling for perceived stress, was $-.10$ ($SE = .02$), with a 95% bias-corrected confidence interval of $[-.14, -.07]$. Both indirect effects were statistically significant, indicating that perceived stress and negative cognitive bias independently mediated the relation between trait mindfulness and emotional distress. The mean estimate of the indirect effect of trait mindfulness on emotional distress in which negative cognitive bias influenced perceived stress was $-.04$ ($SE = -.01$), with a 95% bias-corrected confidence interval of $[-.05, -.02]$, suggesting serial mediation. However, contrast analyses revealed that the serial indirect effect was significantly smaller than the unique indirect effects through negative cognitive bias (mean estimate = $-.07$, $SE = .02$; 95% CI $[-.11, -.03]$) and perceived stress (mean estimate = $-.03$, $SE = .01$; 95% CI $[-.001, -.05]$). The unique indirect effect through negative cognitive bias did not differ in magnitude from the unique indirect effect through perceived stress (mean estimate = $-.04$, $SE = .02$; 95% CI $[-.09, -.003]$).

Discussion

Across two data analytic techniques, evidence from study 2 supported the hypothesis that negative cognitive bias and perceived stress account for unique variance in the mindfulness–emotional distress association. Results revealed that less negative cognitive bias and less perceived stress are independent mechanisms through which trait mindfulness is related to emotional distress, regardless of whether negative cognitive bias and perceived stress are assumed to be causally related or

not. Again, the indirect effects of negative cognitive bias and perceived stress did not differ in size. However, the unique indirect effects through negative cognitive bias and perceived stress were larger in magnitude than the serial indirect effect.

General Discussion

The inverse association between trait mindfulness and emotional distress is well established (e.g., Brown et al. 2007; Desrosiers et al. 2013). Two mechanisms have been proposed (negative cognitive bias and stress reduction) to explain this association, but they have not been examined in conjunction. Across two studies, we found that both mechanisms explained unique variance in the relation between trait mindfulness and emotional distress. That is, negative cognitive bias and perceived stress independently mediated the relation between trait mindfulness and emotional distress. Thus, mindfulness may buffer against or reduce depression and anxiety by decreasing negative cognitive bias and reducing stress.

The present findings reveal negative cognitive bias to be a mechanism, distinct from reduced stress, through which trait mindfulness is related to less emotional distress. This is consistent with numerous studies identifying the link between mindfulness and cognitive styles that emphasize negativity (e.g., Frewen et al. 2008). Furthermore, the present findings align with Kiken and Shook (2012) who conducted mediational analyses and found that negative cognitive bias partially mediated the relation between trait mindfulness and emotional distress. The present work though expands on these findings by showing that negative cognitive bias accounts for significant variance in the trait mindfulness–emotional distress association, and that variance accounted for is unique from the variance accounted for by lower levels of stress. That is, the findings reveal that the stress reduction model of mindfulness cannot account for the mediating role of negative cognitive bias in the relation between trait mindfulness and emotional distress.

Similarly, less perceived stress is a mechanism independent of negative cognitive bias through which trait mindfulness is related to less emotional distress. This finding lends support to the stress reduction account of mindfulness (Creswell and Lindsay 2014) and is consistent with other work that found perceived stress to be negatively associated with mindfulness and positively associated with emotional distress (Bergin and Pakenham 2016). However, to the authors' knowledge, this is first study to test whether perceived stress is a mechanism that explains how mindfulness is associated with emotional distress using mediational analyses. The mediating role of perceived stress is supported by evidence that changes in self-reported trait mindfulness preceded changes in perceived stress during a mindfulness-based intervention (Baer et al. 2012). Taken together, the present research suggests that stress

reduction is a mechanism of action for mindfulness distinct from negative cognitive bias.

The present research indicates that negative cognitive bias and perceived stress are independent mediators of the mindfulness–emotional distress association. However, alternative, serial mediational analyses were also supported. In both studies, there was evidence that mindfulness is associated with less negative cognitive bias which in turn was related to less perceived stress, which ultimately was associated with lower levels of emotional distress. In other words, not only was there evidence that negative cognitive bias and stress are unique mediators but there was also evidence that these two mechanisms operate in serial. This finding provides initial support for the stress reduction account of mindfulness (Creswell and Lindsay 2014), which theorizes that mindfulness mitigates threat appraisals which in turn reduces stress. However, the magnitude of the serial mediation indirect effects tended to be smaller than the indirect effects through either single mediator (controlling for the other mediator). In both studies, the unique indirect effect through negative cognitive bias was larger than the serial indirect effect. In study 2, the unique indirect effect perceived stress was also larger than the serial indirect effect. Thus, considering negative cognitive bias and perceived stress as independent mediators, rather than mediators operating in serial, accounts for more variance in the mindfulness–emotional distress association.

Across the two studies and two data analytic techniques, the results were consistent regarding the relative magnitude of the indirect effects of trait mindfulness on emotional distress through perceived stress and negative cognitive bias. In both studies, the magnitude of the indirect effects through perceived stress did not significantly differ from the indirect effects through negative cognitive bias. This finding suggests that neither the stress reduction nor negative cognitive bias models of mindfulness account for more of the variance in the mindfulness–emotional distress association. Both mechanisms seem to account for roughly the same amount of unique variance.

Limitations and Future Directions

It is important to note some of the limitations of the present work. First, both studies were cross-sectional and correlational. Therefore, the temporal and causal assumptions of mediation are not met. Future studies may utilize experimental designs to investigate whether brief state mindfulness inductions or mindfulness-based interventions that increase trait mindfulness cause reductions in perceived stress and negative cognitive bias. Second, the present studies used convenience samples of relatively healthy college students, which may limit the generalizability of the current findings (e.g., Arnett 2008). Third, the studies relied solely on self-report measures, raising concerns of social desirability and common method variance

(e.g., Doty and Glick 1998). Future research should use other assessment strategies (e.g., physiological measures of stress response or more objective measures of negative cognitive bias).

Author Contributions CGF designed and executed the study, conducted data analysis, and wrote the paper. NJ collaborated with the design and execution of the study, consulted on data analytic procedures, and collaborated with writing and editing the manuscript.

Compliance with Ethical Standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of West Virginia University and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest The authors declare that they have no conflict of interest.

Informed Consent Statement Informed consent was obtained from all participants before participation.

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