

Positive Reappraisal Mediates the Stress-Reductive Effects of Mindfulness: An Upward Spiral Process

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Abstract The stress-reductive effect of mindfulness practice is well-established, yet less is known about the cognitive mechanisms underlying this salutary outcome. We conducted a prospective observational study of 339 participants (mean age 45.7 ± 13.4) undergoing an 8-week mindfulness-based stress and pain management course and found support for our hypotheses that a) pre-post intervention increases in dispositional mindfulness are reciprocally linked with increases in positive reappraisal coping and b) the stress-reductive effects of increases in dispositional mindfulness are mediated by increases in positive reappraisal independent of changes in catastrophizing. Positive reappraisal and mindfulness appear to serially and mutually enhance one another, creating the dynamics of an upward spiral. Through mindfulness practice, individuals may engender a broadened state of awareness that facilitates empowering interpretations of stressful life events, leading to substantially reduced distress. Study findings have implications for cognitive therapy that couples mindfulness practices with restructuring techniques oriented toward benefit finding and positive reappraisal.

Keywords Mindfulness · Reappraisal · Stress · Catastrophizing · Positive emotion · Upward spiral

Introduction

Mindfulness meditation-based interventions are increasingly well-regarded in the psychological and medical literatures for their therapeutic efficacy in reducing distress (Greeson 2008). According to modern psychological operationalization of this multidimensional construct, the *practice* of mindfulness (which involves repeated placement of attention onto an object while alternately acknowledging and letting go of distracting thoughts and emotions) engenders a transitory *state* of mindfulness, which, when engaged repeatedly over time, may accrue into *trait* or *dispositional* mindfulness (Chambers et al. 2009; Garland et al. 2010). The state of mindfulness is characterized by an attentive and nonjudgmental metacognitive monitoring of moment-by-moment cognition, emotion, perception, and sensation without fixation on thoughts of past and future (Garland 2007; Kabat-Zinn 1982; Lutz et al. 2008), while trait mindfulness reflects the propensity towards exhibiting such nonjudgmental awareness in everyday life. Although research has established that the practice of mindfulness leads to significant stress reduction (for reviews, see Baer 2003; Chiesa and Serretti 2009; Grossman et al. 2004), relatively little is known about the mechanisms underlying the salutary effects of mindfulness on stress.

Meditative practices such as mindfulness meditation have been construed by some as relaxation techniques, believed to reduce stress via evocation of a relaxation response (Benson et al. 1974). However, mindfulness meditation has been shown to produce significantly different cardiovascular and autonomic effects than relaxation training (Ditto et al. 2006), giving weight to the criticism against the conceptualization of mindfulness practice as a mere relaxation technique (Bishop 2002). Moreover, a randomized controlled trial showed that while both mindfulness practice and relaxation training reduced

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distress and produced positive mood states, only mindfulness practice led to significant decreases in ruminative thoughts which partially mediated its therapeutic effect on distress (Jain et al. 2007). Such findings underscore the notion that mindfulness meditation may reduce stress through mechanisms other than relaxation, including modification to cognitive–emotional coping processes.

Negative cognitive habits such as rumination and catastrophizing have been shown to exacerbate and prolong experiences of psychological distress (e.g., Nolen-Hoeksema 2000), and consequently, much attention has been paid to the therapeutic effects of mindfulness meditation on such maladaptive cognitive coping processes. Yet, less research has focused on the effects of mindfulness practice on positive cognitive coping strategies. Elsewhere, we (Garland et al. 2009, 2010) have posited that mindfulness practice may facilitate one such strategy, *positive reappraisal*, i.e., the adaptive process through which stressful events are re-constructed as benign, beneficial, and/or meaningful. This cognitive coping strategy (alternately conceptualized as *benefit-finding*) is associated with reduced distress and improved mental health outcomes (Helgeson et al. 2006) and also appears to impact physiological parameters associated with stress (Bower et al. 2008; Carrico et al. 2006; Cruess et al. 2000; McGregor et al. 2004; Tugade and Fredrickson 2004). Unlike denial or suppression, which can result in increased sympathetic nervous system activation (Gross and Levenson 1997) and behavioral avoidance, which can exacerbate future experience of stress (Holahan et al. 2005; Taylor and Stanton 2007), positive reappraisal is an active, meaning-based coping strategy (Folkman 1997) that is often the first step towards a productive reengagement with the stressful event. For example, a person first diagnosed with cardiovascular disease might positively reappraise the diagnosis as an opportunity to change their lifestyle and health behaviors rather than see it as a catastrophe portending imminent doom. How might mindfulness be linked with this adaptive cognitive process?

According to the mindful coping model (Garland et al. 2009) depicted in Fig. 1a, to re-construct an appraisal of a given event as positive, one must first disengage and withdraw from the initial, negative appraisal into a transitory metacognitive state that attenuates semantic evaluations associated with the event. Thus, when a given event is appraised as a threat that exceeds one's capabilities, an individual may initiate an adaptive response by decentering from this stress appraisal via a process of mindfulness, which leads to a state of mindful awareness. This state is characterized by broadened attention and increased cognitive flexibility. From the vantage point of this expanded, metacognitive state, individuals can then more easily reappraise their circumstances and redefine or

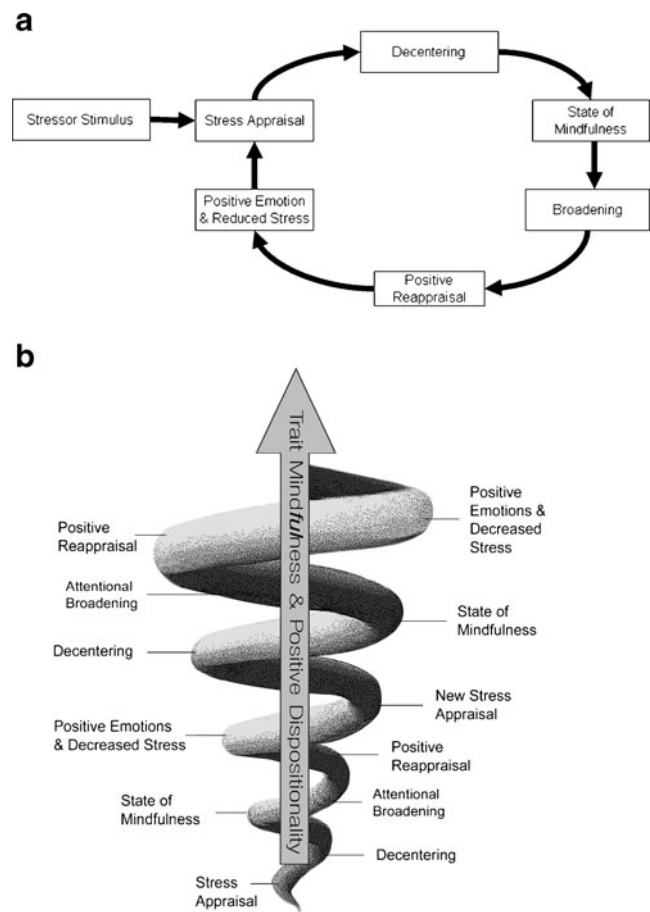


Fig. 1 **a** The mindful coping model: cross-sectional view (Garland et al. 2009). **b** The mindful coping model: longitudinal view (Garland et al. 2010)

reframe them as meaningful or even beneficial and, in so doing, reduce stress while promoting the experience of positive emotions, such as hope or challenge. Recurrent engagement of this metacognitive state via mindful effort may result in the establishment of mindful dispositionality, which, in turn, could lead to a heightened propensity toward making positive reappraisals in the face of distress as a cognitive coping style (see Fig. 1b).

Thus, to the extent that the broadened mental state of mindfulness leads to positive reappraisal, by virtue of the reciprocal links between emotions and cognition as specified in the broaden-and-build theory (Fredrickson 2004) and identified by affective neuroscience (Pessoa 2008), positive reappraisal may in turn result in mindfulness. Concomitantly, mindfulness and positive reappraisal may be components of an *upward spiral* (Garland et al. 2010), a cognitive–emotional system that can counter the self-perpetuating and damaging cycles triggered by negative emotions and ultimately lead to optimal functioning.

Upward spiral processes have been observed in prospective correlational research that indicates initial positive

emotional experiences predict future positive emotional experiences, in part by broadening cognition and promoting positive coping (Burns et al. 2008; Fredrickson and Joiner 2002). When positive emotions expand people's mindsets, these cognitive effects may reciprocally increase the frequency and intensity of positive emotions, as one increasingly focuses attention on pleasurable, beautiful, rewarding, or meaningful objects and events. By engendering awareness of positive experiences and perspectives, positive emotions tend to accrete over time, leading to more frequent positive emotions in the future. Indeed, we propose that upward spirals of positive emotions may be keys to fostering resilience in the face of adversity (Fredrickson et al. 2003; Tugade and Fredrickson 2004).

The aim of the present study was to provide an initial and partial test of the mindful coping model in participants undergoing an 8-week group mindfulness training program. We had three primary hypotheses. One, increases in trait mindfulness from baseline to program completion will predict growth in positive reappraisal. Two, increases in positive reappraisal from baseline to program completion will predict growth in mindfulness. Three, the effect of increases in trait mindfulness on decreases in stress will be mediated by increases in positive reappraisal. As a competing hypothesis for hypothesis 3, we sought to test the proposition that increased mindfulness leads to disruptions in catastrophizing, thereby reducing the threat value of a given stimulus and resulting in decreased stress (Garland 2007).

In addition, given the reciprocal spirals between mindfulness and reappraisal postulated by the mindful coping model, other model specifications are possible. Hence, we conducted multivariate path analyses to test two alternative models: a model where the effect of change in mindfulness on change in stress was mediated by change in positive reappraisal or in catastrophizing; and a model where the effect of change in positive reappraisal might mediate the effect of change in mindfulness on change in perceived stress. If our three primary hypotheses were supported, it would suggest that, independent of the effects of mindfulness practice on catastrophizing, mindfulness training may engender a mindful disposition that facilitates the generation of positive reappraisals in the face of acute and chronic stressors, thereby undoing the stress reaction and its consequences.

Methods

Participants and Procedure

Study participants ($N=339$) were recruited from those participants who chose to enroll in the UNC Mindfulness-

Based Stress and Pain Management Program (MSPM) during 2008–2009. This Program, based on the Mindfulness-Based Stress Management (MBSR) program originally developed in 1985 by Jon Kabat-Zinn and Saki Santorelli at the University of Massachusetts Medical Center, has offered 8 week mindfulness training programs over the last 10 years at University of North Carolina at Chapel Hill, to over seven hundred participants. Adults who register for the course typically suffer from a wide array of stress- and pain-related symptoms, including anxious thoughts and feelings, depressed mood, sleep disturbances, anger and irritability, chronic skeletal muscular pain, tension headaches and migraines, gastrointestinal distress, and cardiopulmonary discomfort. For this study, participants were recruited by the program coordinator, who informed potential participants of the opportunity to be involved in research at the time of registration. Study participants were compensated for their time spent completing pre- and post-course questionnaires, by having their course fee reduced by \$25. The current research, which consisted of a prospective observational study of participants of the MSPM program, was approved by the UNC School of Medicine Institutional Review Board.

Measures

Mindfulness The *Five Facet Mindfulness Questionnaire* (FFMQ, $\alpha=0.81$ in the present sample), comprised of 39 Likert-type items, was used to measure self-reported mindfulness. The FFMQ yields a total score based on the following five facets: nonreactivity to inner experience, tapped by items such as "I watch my feelings without getting lost in them"), observing and attending to experience (e.g., "I pay attention to sensations, such as the wind in my hair or the sun on my face"), describing and discriminating emotional experiences (e.g., "I'm good at finding words to describe my feelings"), nonjudging of experience (e.g., "I tell myself I shouldn't be feeling the way that I am feeling"), and acting with awareness (e.g., "I find myself doing things without paying attention"; Baer et al. 2006).

Perceived Stress The 14-item *Perceived Stress Scale* (PSS-14, $\alpha=0.85$ in the present sample) was used to assess on a five-point scale how often (0=never, 4=very often) in the past month participants found their lives unpredictable, uncontrollable, and overwhelming (Cohen et al. 1983) and includes items like "How often have you felt nervous and 'stressed'?" and "How often have you felt that you were on top of things?"

Cognitive Coping Strategies The positive reappraisal and catastrophizing subscales of the Cognitive Emotion Regu-

lition Questionnaire (CERQ; Garnefski et al. 2001) were administered to evaluate cognitive coping. The CERQ consists of 36 Likert scaled items that assess how often certain cognitive strategies are employed to cope with stressful life events. The positive reappraisal subscale ($\alpha=0.85$) includes items such as “I think I can learn something from the situation,” and “I think I can become a stronger person as a result of what happened.” Items assessing catastrophizing ($\alpha=0.70$) include “I keep thinking how terrible it is what I have experienced” and “I often think what I have experienced is the worst that can happen to a person.” The CERQ has been shown to have good internal consistency and convergent validity with subscales of the SCL-90 (Garnefski et al. 2001; Garnefski and Kraaij 2007).

Analytic Strategy

Paired *t* tests were conducted to examine change over time. Hierarchical regression analyses were used to test whether mindfulness and positive reappraisal mutually promote one another (i.e., hypotheses 1 and 2). Two hierarchical regression models employing change scores were used for this analysis (see Table 2). In model one, T2 positive reappraisal was the dependent variable, and T1 positive reappraisal was entered in the first step, followed by change in mindfulness entered in the second step. In model two, T2 mindfulness was the dependent variable, and T1 mindfulness was entered in the first step, followed by change in positive reappraisal entered in the second step (Table 2).

Path analysis via structural equation modeling software (AMOS 17.0) was used to examine whether the effects of changes in dispositional mindfulness on changes in per-

ceived stress were mediated by changes in positive reappraisal and/or catastrophizing (i.e., hypothesis 3). The overall model fit was assessed by examining the chi-square statistic and the comparative fit index (CFI; Bentler 1990), as well as the root mean squared error of approximation (RMSEA) index (Hu and Bentler 1998). The CFI has typical values between 0 and 1, with a value close to 1 indicating good model fit. RMSEA scores closer to 0 indicate better model fit.

Missing Data

With regard to the variables assessed in this study, persons with missing T2 data did not significantly differ from those with complete data on their T1 mindfulness, positive reappraisal, catastrophizing, and stress. Nonetheless, due to possible systematic bias between those participants who did not complete T2 measures and those who did, Little’s (1988) MCAR test was used to examine whether the data were missing completely at random, $\chi^2(173)=253.53$, $p<0.001$. Data were not *missing completely at random*, and thus, listwise deletion of cases with missing data could introduce bias and is therefore inappropriate (Little and Rubin 2002). Multiple imputations (MI) in SPSS 17.0 were used to handle missing data in Pearson R correlations, paired *t* tests, and hierarchical regression analyses. Ten imputed replicate datasets were created, and analyzed in turn. Results from these imputed datasets were combined, and the pooled averages for statistical parameters are subsequently reported, with degrees of freedom corrected for the multiple imputation procedure (Barnard and Rubin 1999). Maximum likelihood estimation (MLE) in AMOS 17.0 was used to handle missing data in structural equation models.

Table 1 Pre–post-mindfulness training changes and correlation matrix of dispositional mindfulness, positive reappraisal, perceived stress, and catastrophizing ($N=339$)

^a	Pre M(SE)	Post M(SE)	<i>t</i> Value	
Mindfulness	117.78 (1.14)	138.81 (1.10)	18.77***	
Reappraisal	12.35 (.20)	14.08 (0.21)	9.96***	
Stress	24.57 (.31)	21.76 (0.25)	-9.35***	
Catastrophizing	8.95 (.14)	8.31 (0.13)	-5.87***	
Baseline correlation matrix				
	Mindfulness	Reappraisal	Stress	Catastrophizing
Mindfulness	1			
Reappraisal	0.34***	1		
Stress	-0.36***	-0.19**	1	
Catastrophizing	-0.22***	-0.02	0.37***	1

^a Analyses conducted on imputed dataset, with *N* adjusted for multiple imputations

SE standard errors are given for the pooled means across the multiple imputations

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 2 Hierarchical regressions of the relationship between growth in mindfulness and growth in positive reappraisal

Order of entry of set	Predictors in set	F for set	T for within-set predictors	df	B	σB	Model R^2
Dependent variable=Time 2 positive reappraisal							
1	Time 1 positive reappraisal	324.77***	10.89	1,329	0.71	0.07	0.49
2	Change in mindfulness	179.60***	3.06	2,328	0.04	0.01	0.52
Dependent variable=Time 2 mindfulness							
1	Time 1 mindfulness	304.84***	8.10	1,329	0.60	0.07	0.47
2	Change in positive reappraisal	173.92***	3.78	2,328	1.14	0.30	0.51

*** $p < 0.001$

Results

Sample Characteristics

With regard to the sociodemographic characteristics of the sample, most participants were female (75.5%), Caucasian (81.1%), and married (58.2%), with a mean age of 45.7 years ($SD=13.4$; range 22–94 years). Over half of participants (55.0%) had family incomes of greater than \$80,000 per year. In addition, 51.4% of participants had an advanced degree. Thus, on average, the sample was highly educated and from a medium–high socioeconomic status.

Pre–Post-Mindfulness Training Changes

Pre–post changes in variables of interest were examined with the imputed dataset. Dispositional mindfulness significantly increased over the 8-week mindfulness training course, $t(21)=18.77$, $p < 0.001$, as did positive reappraisal coping, $t(54)=9.96$, $p < 0.001$. Perceived stress significantly decreased over the course of mindfulness training, $t(35)=-9.35$, $p < 0.001$, as did catastrophizing, $t(86)=-5.87$, $p < 0.001$ (see Table 1).

Zero-Order Correlations

At baseline, dispositional mindfulness was significantly negatively associated with perceived stress and catastrophizing, and significantly positively associated with positive reappraisal. Perceived stress was positively associated with catastrophizing and negatively associated with positive reappraisal, whereas catastrophizing was statistically unrelated to reappraisal (see Table 1).

Positive Reappraisal and Mindfulness Serially and Mutually Influence Each Other

See Table 2 for results of hierarchical regression analyses. In line with our first hypothesis, hierarchical regression analysis revealed that change in mindfulness significantly

predicted T2 positive reappraisal, controlling for T1 positive reappraisal. Similarly, we found that change in positive reappraisal significantly predicted T2 mindfulness, controlling for T1 mindfulness. These findings suggest the presence of positive feedback loops, in which positive reappraisal and mindfulness reciprocally and serially promote one another in an upward spiral.

Mediation Effects between Change in Mindfulness, Positive Reappraisal, Catastrophizing, and Perceived Stress

The procedure proposed by Barron and Kenney (1986) was first employed to test for mediation. First, there was a significant association between the predictor (change in dispositional mindfulness) and the outcome variable (change in perceived stress), $\beta=-0.39$, $p < 0.001$. Second, the predictor was related to the proposed mediator (change in positive reappraisal), $\beta=0.40$, $p < 0.001$. Next, after controlling for the relation between the predictor (change in mindfulness) and the outcome (change in perceived stress), the proposed mediator (positive reappraisal) was related to the outcome (change in perceived stress), $\beta=-0.21$, $p < 0.05$. Finally, the relation between changes in mindfulness and perceived stress was reduced by the inclusion of the mediator (change in positive reappraisal) but remained significant, $\beta=-0.29$, $p < 0.01$, indicative of partial mediation.

Next, we conducted a multivariate path analysis of key aspects of the mindful coping model, where change in either catastrophizing or positive reappraisal could mediate the effects of mindfulness on stress. This model exhibited good fit: $\chi^2/df=1.50$, $p=0.22$; RMSEA=0.04 (0.00, 0.16), CFI=0.99, AIC=27.50. Results indicated that the effect of change in mindfulness on change in perceived stress was partially mediated by change in positive reappraisal, whereas change in catastrophizing was significantly related to change in mindfulness but not to change in stress after statistically controlling for the influence of positive reappraisal (see Fig. 2).

Although change in positive reappraisal was found to partially mediate the effects of increased mindfulness on

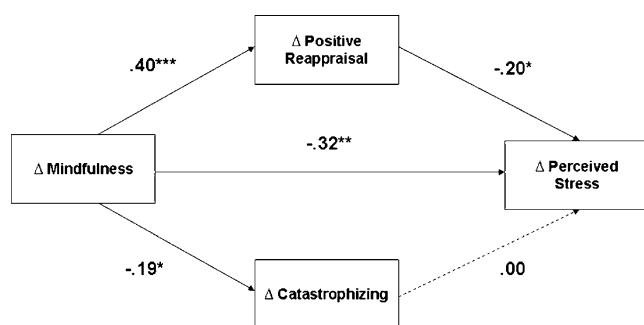


Fig. 2 Path analytic test of the mindful coping model, i.e., the effect of changes in mindfulness on changes in stress mediated by changes in positive reappraisal, while controlling for the effects of changes in catastrophizing. * $p < 0.05$ *** $p < 0.001$. Note: standardized betas are reported. Dotted arrows indicate nonsignificant paths

decreased stress, competing models explicating the pathways between these variables are possible, thus presenting the probability of a specification error. Given the presence of an upward spiral between mindfulness and positive reappraisal suggested by our hierarchical regression analysis, we tested an alternative path model where change in positive reappraisal could have direct stress-reductive effects as well as indirect effects through change in mindfulness and catastrophizing. This model exhibited poor fit: $\chi^2/df=6.79$, $p=0.01$; $RMSEA=0.13$ (0.05, 0.23), $CFI=0.83$, $AIC=32.79$. In this model, change in positive reappraisal coping was found to significantly predict change in mindfulness, which in turn partially mediated reductions in perceived stress, although change in catastrophizing was not found to mediate reductions in perceived stress. Upon comparing fit indices of these two models, the mindful coping model exhibited superior fit to the alternative model. Taken together, our results suggest that the stress-reductive effects of increases in trait mindfulness are partially mediated by growth in positive reappraisal coping.

Missing Data

To determine whether our method for handling missing data (i.e., MI and MLE) substantially influenced results, we re-ran t tests, hierarchical multiple regression analyses, and path analyses without estimating any missing data, using listwise deletion. Results from the listwise deleted dataset were consistent with our MI and MLE analyses (i.e., all statistically significant relationships remained statistically significant).

Discussion

As a whole, this sequence of findings implies the presence of a salutary, upward spiral between dispositional mindful-

ness and positive reappraisal that has significant effects on stress reduction. The present data indicate that increases in dispositional mindfulness predict growth in positive reappraisal, while increases in positive reappraisal predict growth in dispositional mindfulness. Positive reappraisal and dispositional mindfulness appear to mutually and reciprocally enhance one another with the characteristic dynamics of an upward spiral. These findings suggest that increases in the propensity to mindfully decenter from cognitive appraisals and observe present-moment experience in a nonjudgmental fashion may promote positive reappraisal coping over time. Path analysis revealed that increases in dispositional mindfulness reduce stress in part through the mechanism of promoting positive reappraisal, whereas decreases in catastrophizing did not account for the stress-reductive effect of increased dispositional mindfulness in this sample. Hence, the present data provide tentative and partial support for the mindful coping model.

Within the present sample of participants of an 8-week mindfulness training program, it appears as if the salutary effects of mindfulness on stress are partially mediated by strengthening a positive cognitive–emotional process rather than by disrupting a negative one. This finding accords with the upward spiral hypothesis of Fredrickson’s broaden-and-build theory (Garland et al. 2010), which posits that negative emotional systems can be effectively perturbed into more salutogenic configurations via positive affective experiences of sufficient frequency and intensity to broaden awareness and increase adaptive cognitive–behavioral responses. In the present data, increases in one positive cognitive–emotional factor (i.e., mindfulness) promoted growth in another (i.e., positive reappraisal), an upward spiral process that appeared to exert significant therapeutic effects on stress. While reductions in negative and perseverative cognitive factors (i.e., catastrophizing) have been linked with decreased stress in the literature at large (Brosschot et al. 2005), this causal pathway appears to be statistically and conceptually independent of the positive growth process outlined above, at least for this sample. Hence, psychological thriving in the face of adversity is not the result of a mere absence of psychopathology, but instead is underpinned by a distinct set of positive psychological processes that can ameliorate distress, and, as other data suggest, may ultimately lead to flourishing mental health (Fredrickson and Losada 2005).

However suggestive they may be, these data, while prospective, preclude causal inference due to the lack of a control group. Accordingly, changes observed over time in dispositional mindfulness, positive reappraisal, catastrophizing, and perceived stress cannot be directly attributed to mindfulness training, even though such changes occurred after 8 weeks of participation in the MSPM course. Such changes may simply

be the result of the passage of time, exposure to the group dynamic, non-specific therapeutic factors, social desirability bias, or the placebo effect. Additionally, model specification is limited by the available data; for example, relationships between mindfulness, positive reappraisal, and stress might be quite different if a measure for relaxation were entered into the model. Lastly, it should be noted that the presence of missing data, although typical for studies of this nature, was substantial. However, to compensate for this liability, we estimated missing data with two state-of-the-art approaches: MI and FIML. These approaches have been shown to be superior to listwise deletion (Enders and Bandalos 2001), even in cases where the majority of data is missing for a particular variable (Little and Rubin 2002). To corroborate our results, we ran all statistical analyses with listwise deletion and found results consistent with our estimated and imputed models. Future studies with control groups and minimal missing data are needed to replicate our findings.

The present investigation offers tentative evidence for our hypotheses and paves the way for future research. Using micro-analytic research methodologies to probe the unfolding of online emotion regulatory processes over time (for an example of such methods, see Sheppes and Meiran 2007), randomized experiments could examine the effects of mindfulness practice relative to placebo control on the sequential generation of mindful states and positive reappraisals in coping with laboratory stressors to offer a fuller test of the mindful coping model. If controlled, and if experimental research indicates that the practice of mindfulness leads to increases in positive reappraisal, then novel mindfulness-oriented interventions could capitalize on this naturalistic process by combining standard mindfulness exercises with cognitive restructuring techniques oriented toward benefit-finding and positive reappraisal. Through overt training in mindfulness skills coupled with cognitive restructuring techniques, the natural facilitation of positive reappraisals afforded by mindfulness practice might be further augmented. Novel clinical interventions could promote reappraisal by teaching clients to first engage in mindfulness of the breath to decenter from stress appraisals into a broad-minded, flexible mode of awareness, and then to use Socratic questioning to generate positive reappraisals of challenging life events (e.g., “How has dealing with this situation made you a stronger person? How can you learn something from this situation? Is there a blessing in disguise here?”). This therapeutic process would likely involve numerous iterations of mindful decentering and reappraisal within and across multiple treatment sessions, during which time clients could be taught to oscillate between decentering and reappraisal until catastrophic appraisals abate and new, adaptive appraisals are constructed and accepted as valid. The ultimate goal of such a therapeutic process would be to help the client to re-construe adverse circumstances in

his or her life as meaningful opportunities for growth or sources of benefit. Clinical trials are needed to ascertain whether adding mindfulness and positive reappraisal training to cognitive-behavior therapy facilitates reappraisal and thereby would be an effective means of reducing distressing thoughts and emotions.

Because emotional processing of stressful life events unfolds over time, it involves the dynamic adaptation and engagement of attentional and appraisal mechanisms that themselves vary over time (Gross and Thompson 2007; Kalisch 2009). Indeed, this dynamic unfolding may involve processing of the original triggering stimulus and one’s own cognitive, emotional, behavioral, and physiological reaction to that stimulus, which can then reciprocate in a re-processing or reappraisal of the trigger stimulus in a recurrent or iterative manner. Cognitive neuroscience offers a useful lens through which to elucidate the micro-dynamics of this complex process. Based on current neuroscientific findings, we offer the following speculation about the neural mechanisms involved in the process of mindful coping with stress. During stress appraisal, affective processing circuits involving the amygdala, medial temporal lobe, and medial prefrontal and orbitofrontal cortices appear to compute the hedonic or threat value of the stimulus according to previously established stimulus-reinforcement contingencies (LeDoux 2002). Invoking the state of mindfulness via meditation practices seems to modulate activations in anterior cingulate, medial (mPFC), and dorsolateral prefrontal cortices (dlPFC; Chiesa and Serretti 2010; Holzel et al. 2007), which may enable self-monitoring of stress reactivity and attentional disengagement from stress appraisals. Moreover, recent research suggests that mindfulness training attenuates activation in brain areas (i.e., mPFC) that instantiate self-referential, linguistic processing during negative affective experience while enhancing activation in brain regions subserving interoception (i.e., insula; Farb et al. 2010). This pattern of activation suggests that mindfulness training promotes interoceptive recovery from emotional distress, a refocusing from the semantic to the sensory aspects of a distressing experience.

This decentered, metacognitive vantage point afforded by mindfulness practice may then facilitate the set shifting process of cognitive reappraisal, where, according to Kalisch’s (2009) meta-analysis of 13 neuroimaging studies, brain activations appear to spread from left to right PFC and posterior to anterior parts of the cortex. Following Kalisch’s (2009) summary of the neuroscience findings on reappraisal, as alternate construals of the stressor and its meaning in the present socio-environmental context are intentionally retrieved from memory, posterior left lateral frontal cortex may activate. Concomitantly, posterior dorsal and ventral mPFC appear to engage and attenuate emotional interfer-

ence during this process. Subsequent to the retrieval of new appraisals, activation of working memory circuits in right anterior regions of the mPFC and dlPFC may enable metacognitive evaluation of appraisals for their personal significance (i.e., how compatible is the reappraisal with one's self-concept and long-term goals?), leading to further reappraisal or changes in problem-focused coping strategies. Clearly, the dynamic, neurocognitive process of mindful coping outlined here is informed speculation, but speculation worthy of future empirical investigation.

This present research joins growing evidence to show that positive psychological processes are often fueled by the reciprocal dynamics of upward spirals (Burns et al. 2008; Catalino et al. under review; Fredrickson et al. 2003; Kok and Fredrickson under review; Sheldon and Houser-Marko 2001) or alternatively, "gain spirals" (Lindsley et al. 1995; Salanova and Llorens 2011; Salanova et al. 2011). Such positive dynamics are not merely intrapsychic, as indicated here, but have also been shown to extend to both physiological (Burns et al. 2008; Kok and Fredrickson 2011) and organizational (Salanova et al. 2011; Spreitzer et al. 2005) processes. Notably, these positive dynamics can be self-sustaining, as the outputs of the system are simultaneously energizing inputs to the system. Also, because positive emotions can be effectively self-generated (Fredrickson et al. 2008), upward spiral dynamics can also be recharged, given that the key energizing input of positive emotions is a renewable resource (cf., Spreitzer et al. 2005).

Current findings suggest that through the practice of mindfulness, individuals develop an expanded, nonjudgmental state of present-moment awareness that facilitates empowering interpretations of stressful life events, reducing distress via the activation of an upward spiral of positive psychological processes. These findings accord with certain mindfulness traditions, which hold that the awakened mind is not a blank or neutral state, but a fundamentally "positive" state of being. Indeed, the Shambhala Buddhist literature describes this quality as "basic goodness" (Trungpa 1985). By broadening one's perspective and becoming mindful of the "basic goodness" in life, one may come to find benefit in challenges and re-construct them as meaningful opportunities for growth and actualization. In this sense, mindfulness and reappraisal may be linchpins of resilience, unlocking the basic human potential to thrive amidst the unrelenting demands of living.

Acknowledgments Eric L. Garland was supported by Grant Number T32AT003378 from the National Center for Complementary and Alternative Medicine and a Francisco J. Varela Research Grant from the Mind and Life Institute, Boulder, CO.

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