



A multi-method examination of the effects of mindfulness on stress attribution, coping, and emotional well-being

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ABSTRACT

Mindful individuals orient to ongoing events and experiences in a receptive, attentive manner. This experiential mode of processing suggests implications for the perception of and response to stress situations. Using laboratory-based, longitudinal, and daily diary designs, four studies examined the role of mindfulness on appraisals of and coping with stress experiences in college students, and the consequences of such stress processing for well-being. Across the four studies (n 's = 65 – 141), results demonstrated that mindful individuals made more benign stress appraisals, reported less frequent use of avoidant coping strategies, and in two studies, reported higher use of approach coping. In turn, more adaptive stress responses and coping partially or fully mediated the relation between mindfulness and well-being. Implications for the role of mindfulness in stress and well-being are discussed.

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1. Introduction

Throughout their lives, people are exposed to acute and chronic demands that can negatively impact them in a variety of physical and psychological ways. Yet while all individuals face demands and challenges, there are notable inter-individual and intra-individual variations in responses to such life events that have important consequences for well-being (Larsen, 2000). In recent years there has been considerable research interest in *mindfulness* as a protective factor with regard to the effects of difficult life events. Mindfulness concerns a receptive state of mind wherein attention, informed by a sensitive awareness, simply observes what is taking place in the present (Brown & Ryan, 2003; Brown, Ryan, & Creswell, 2007).

Empirically, research on dispositional mindfulness, experimentally induced mindful states, and mindfulness training programs have shown that this attribute is related to or predicts a variety of mental health and well-being indicators (e.g., Broderick, 2005; Brown & Ryan, 2003; Shapiro, Brown, & Biegel, 2007). These findings have led researchers to speculate about the processes through which such benefits may accrue (e.g., Baer, 2003; Shapiro, Carlson, Astin, & Freedman, 2006). In line with these interests, the present series of studies focus on processes that may mediate these relations between mindfulness and psychological well-being. We specifically examine whether mindfulness alters the stress process by attenuating negative appraisals of stress in demanding situations

and by facilitating the use of adaptive forms of coping with stressful situations. In turn, we examine whether mindfulness helps to support psychological well-being through the adaptive use of those regulation strategies. This model is implied by a series of related studies described below; and has been assumed, but not investigated directly in coherent and externally valid research. These set of studies are therefore designed to provide the empirical foundation for further investigation into mindfulness effects on stress, coping, and well-being.

To date, most research on the effects of mindfulness on stress, mood, and other indicators of mental health and well-being has been conducted within the context of treatment interventions, including mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990) and mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002). The primary aim of these interventions is to cultivate mindful presence to facilitate stress reduction and enhance well-being. Controlled and uncontrolled trials with MBSR, MBCT, and other mindfulness-based and mindfulness-integrated interventions have demonstrated success in producing these and other effects over both short- and long-term follow-up periods (see Baer, 2003 and Grossman, Niemann, Schmidt, & Walach, 2004 for meta-analytic reviews).

Mindfulness-based interventions have multiple components, including mindfulness practice exercises, didactic instruction, and social support; so it is unclear to which ingredients the well-being effects of these interventions can be attributed (Bishop, 2002). But recent research suggests that mindfulness itself has well-being consequences. For example, Brown and Ryan (2003) found that both trait and state mindfulness predicted lower levels of negative

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affect over 2- and 3-week periods in student and community adult samples, respectively. Both Brown and Ryan (2003) and Shapiro et al. (2007) found that increases in mindfulness over the course of MBSR training were related to declines in anxiety, mood disturbance, and other indicators of poor psychological well-being.

The processes through which mindfulness has salutary effects on well-being have received very limited empirical attention to date. Nonetheless, based on the emerging theory and evidence (e.g., Baer, 2003; Bishop, 2002; Brown et al., 2007; Shapiro et al., 2006), we suggest two primary ways through which mindfulness may produce salutary effects. First, mindfulness may promote a less defensive, more willing exposure to challenging and threatening events and experiences, which may reduce negative cognitive appraisals of those situations, thus rendering lower levels of perceived stress. Second, mindfulness may foster an enhanced capacity to adaptively cope with situations perceived as challenging, threatening, or harmful. That is, we hypothesize that mindfulness will be related to both a lower tendency to appraise or construe events as stressful, and more adaptive coping in stressful situations. A considerable body of research indicates that both factors are important to well-being outcomes (e.g., Folkman, Lazarus, Gruen, & DeLongis, 1986).

1.1. Stress appraisals

Stress appraisals concern the cognitive processes through which an individual evaluates or appraises events. Most basically, events are perceived as good, bad, or neutral, positive or negative, or as involving challenge (generally positive appraisals) or threat, harm, or loss (negative appraisals). Individuals often appraise a situation in a way that alters its emotional significance or meaning, either by changing their view of the situation or their perceived capacity to manage the demands that it presents. Of key interest to us in this process is the extent to which situations are appraised as negative, too demanding, or as *stressful* (Cohen, Kessler, & Underwood Gordon, 1995; Gross & Thompson, 2007). The experience of stress specifically results not only from events themselves but also from the appraisal that such events tax or exceed a person's adaptive capacity (e.g., Cohen, Kamarack, & Melmelstein, 1983; Lazarus, 1977).

Why should mindfulness alter cognitive appraisals of events? First, the quality of attention that is brought to bear on situations is thought to impact cognitive appraisals (Gross & Thompson, 2007). While much of the literature on attentional deployment in the appraisal process has focused on forms that can have mixed or negative appraisal consequences, such as distraction and rumination, theory and research suggest that mindful attention may promote more adaptive appraisals. Several authors have argued (e.g., Baer, 2003; Brown et al., 2007) that mindfulness involves a greater willingness or ability to receptively process internal and external stimuli as they occur. This stands in contrast to a conceptually driven mode of processing in which occurrences are habitually filtered through conditioned evaluations, memories, beliefs, and other forms of cognitive manipulation (see Brown et al., 2007). If mindfulness fosters more objectively informed responding, then situations can potentially be viewed in more benign or neutral terms. Recent research supports this claim, showing that mindfulness promotes desensitization and a reduction in emotional reactivity to potentially threatening stimuli (Arch & Craske, 2006; Broderick, 2005; Creswell, Way, Eisenberger, & Lieberman, 2007). Thus, mindfulness may promote cognitive change by a 'turning down' or attenuation of negative appraisals of events. Given the key role of cognitive appraisal in emotional and other mental health outcomes, we suggest that one process through which mindfulness may enhance mental health and well-being is a reduced tendency to perceive situations in stress-inducing ways.

1.2. Coping responses

In the literature on stress processes, considerable attention has been given to *coping*, a class of affect regulation strategies that operate by altering physiological, experiential, or behavioral responses to stressful situations (Gross & Thompson, 2007; Larsen, 2000). Coping encompasses a range of activities, including behavioral engagement (e.g., problem-solving), behavioral disengagement (e.g., substance use), emotional expression, and such "emotion-focused" activities as exercise and relaxation. Coping has been broadly classified into avoidant and approach types (Roth & Cohen, 1986). *Avoidant coping* reflects a defensive form of regulation that involves ignoring, distorting, or escaping threatening stimuli. Several research groups have conceptualized avoidant coping in terms of behavioral disengagement, mental disengagement, and denial (e.g., Deisinger, Cassisi, & Whitaker, 1996; Fontaine, Manstead, & Wagner, 1993; Stowell, Kiecolt-Glaser, & Glaser, 2001). While avoidant coping can reduce distress in the short-term, it is ultimately ineffective in supporting well-being (Davies & Clark, 1998). In contrast, *approach coping* involves a cognitive, emotional, or behavioral 'turning toward' stressful situations. Three predominant forms have been consistently identified: active coping (direct action to deal with a stressful situation), acceptance (cognitive and emotional acknowledgement of stressful realities), and cognitive reinterpretation (learning, finding the good in the threat, harm, or loss situation, or choosing to use the situation to develop as a person) (e.g., Fortune, Richards, Main, & Griffiths, 2002; Lyne & Roger, 2000; Stowell et al., 2001). Approach coping is generally considered adaptive in that effort is directed toward resolving stressful situations or overcoming the stress associated with them. As a result, these strategies are believed to facilitate the assimilation and transcendence of stress in a way that ultimately enhances well-being (Shontz, 1975).

There is a theoretical basis to hypothesize that mindfulness supports adaptive (less avoidant, more approach) coping. Specifically, if more mindful individuals are able or willing to objectively observe internal events, thoughts, and emotions as they occur instead of engaging in past- or future-oriented negative or distorted thinking patterns (e.g., rumination, catastrophizing), they may be more likely to cope in adaptive ways, rather than in ways that can perpetuate stress and ill-being (McCullough, Orsulak, Brandon, & Akers, 2007). Additionally, mindful states are characterized by fuller levels of attention, and such attention during stressful experiences are thought to reduce distortion and dysregulation in systemic affective responding (Larsen, 2000), indicated by higher use of approach and lower use of avoidant coping. Initial evidence, though indirect, suggests that mindfulness may promote less avoidant coping, in that trait mindfulness has been associated with lower levels of rumination, thought suppression, and other negative thinking styles associated with poorer emotional outcomes (e.g., Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Shapiro et al., 2007). Despite these studies' contributions to understanding effects of mindfulness on stress and coping, mindfulness effects have not been addressed in a systematic way.

One way in which research efforts have not systematically addressed mindfulness effects has been by exploring potential confounds for these effects. In fact, there is a notable lack of research demonstrating these effects are independently predictive when accounting for other personality characteristics expected to influence stress responses. In other words, mindfulness has not been differentiated from other personality characteristics and shown to independently predict adaptive coping and stress responses. The question arises, is it that mindfulness influences stress, or that individuals who are mindful also have other positive attributes, allowing them to more adaptively respond to stress? Two possible constructs that could be responsible for the effects

of mindfulness are *optimism* and *neuroticism*. Both are relevant because they have demonstrated high relations (neuroticism: $r = -0.56, p < 0.01$; optimism: $0.27-0.34, p$'s < 0.01) with mindfulness in past research (Brown & Ryan, 2003), and both have been inextricably linked to perceived stress (Brissette, Scheier, & Carver, 2002; Costa & McCrae, 1990; Scheier & Carver, 1992), stress-related appraisals (Chang, 1998; Penley & Tomaka, 2002), avoidant and active coping styles (Friedman et al., 1992; Scheier & Carver, 1992; Suls, David, & Harvey, 2006), and well-being (Andersson, 1996; Costa & McCrae, 1980). Constructs such as these have not, to the authors' knowledge, been systematically assessed to determine their influence on mindfulness and stress relations.

With this research as background, the present studies were designed for three primary purposes. First, we sought to examine the role of mindfulness in fostering adaptive responses to situations that carry the potential for stress initiation or maintenance. We specifically examined the role of mindfulness in altering processes of cognitive appraisal and coping, two key regulatory processes in the stress and well-being dynamic. Second, we examined whether the greater use of adaptive coping and lower stress appraisal can help to explain the positive well-being effects of mindfulness. We thus hypothesized that trait mindfulness would predict more benign cognitive evaluations of stressful situations, as well as the use of more adaptive coping strategies. We also predicted that both of these factors would mediate the relations between dispositional mindfulness and well-being outcomes. Finally, we examined in early studies whether mindfulness effects on stress and coping were independent of dispositional optimism and neuroticism; two personality constructs that play a central role in stress responses. We hypothesized these effects would hold even when controlling for these constructs.

To test these hypotheses, four studies were conducted using multiple methods. Studies 1 and 2 were designed to test whether the effects of mindfulness were present when controlling for neuroticism and optimism. In Study 1, we also tested our hypotheses under controlled laboratory conditions with a specific cognitive stressor. In the three remaining studies, we moved to naturalistic settings to establish the external validity of the relations between mindfulness, stress processes, and well-being. Because Study 1 utilized a lab design, we were also able to administer an assessment of performance after the stressful task. Study 2 tested the stability of the relations between our variables of interest using a short-term longitudinal design. Study 3 was designed to examine these relations using an experience sampling methodology in which the psychological features of stressful encounters could be examined in real time. Finally, Study 4 tested our hypotheses in the context of a specific real-world stress encounter that unfolded over time (cf., Folkman & Lazarus, 1985).

2. Study 1

We have argued that mindfulness, as an open, or receptive attention to present experience, may facilitate non-defensive processing of threatening experience, and thereby produce more adaptive responding in challenging or threatening situations, with salutary well-being consequences. Study 1 was conducted in a controlled laboratory context to examine these relations. To test our hypotheses, we selected one of the more stressful experiences that humans face, namely social evaluation. As social creatures, humans have an inherent need to belong (e.g., Deci & Ryan, 2000; Ryan, 1995), and are highly motivated to avoid social demotions and exclusions (e.g., Allen & Knight, 2005; Leary, 2004). The perception of negative evaluation, even by strangers, can readily provoke psychological distress (e.g., Leary, 2004).

Laboratory-based paradigms to examine responses to social stress are a primary means to examine such responses (Dickerson & Kemeny, 2004). The present study tested immediate post-stressor appraisal responses, as well as the capacity for stress recovery through coping. Ill-being, reflected in the experience of general anxiety, was assessed at several points in the stress encounter, and performance was assessed at the end of the study. In accord with our hypotheses, we tested whether more mindful individuals would report less negative cognitive appraisals of the stress situation and more adaptive coping with the threat entailed. We then tested whether these regulatory efforts would help to explain more mindful individuals' lower levels of anxiety and higher performance in the aftermath of social evaluative threat.

3. Method

3.1. Participants

Sixty-five undergraduates (54 women, 11 men) ranging in age from 18 to 22 ($M = 19.91, SD = 1.21$) participated for extra course credits. Seventy-six percent were Caucasian, 15% Asian-American, 5% African-American, and 4% identified with another race or ethnicity.

3.2. Procedure

The study was conducted in a single laboratory session. A packet of self-report measures, including assessments of mindfulness and baseline stress and anxiety, was first completed, after which participants received a stress induction adapted from Cheng (2003). Specifically, they performed a 3-min mental arithmetic task requiring multiplication of three-digit numbers while a female experimenter sat across the table with a stopwatch, timing and recording answers. State levels of anxiety and stress were measured 5 min after task engagement (2 min after its completion) and again 30 min after task engagement (27 min after completion). At the latter time point, a measure of coping, referenced to the task and its aftermath, was also completed. In the intervening time interval participants completed filler tasks consisting of mildly challenging games that were intended to prevent boredom but not induce further stress. Finally, before leaving, participants were asked to complete a set of up to eight mazes in 5 min, to assess capacity for concentration and creative thinking, and consequent performance after the stressful task.

3.3. Measures

3.3.1. Mindfulness

To assess this quality, the *Mindful Attention Awareness Scale* (MAAS, Brown & Ryan, 2003) was used. The MAAS has been extensively validated and used in a number of previous studies (see Brown et al., 2007 for review). Participants responded to a validated five-item adaptation of the trait MAAS (see Brown & Ryan, 2003) using a 1–6 (*almost always* to *almost never*) Likert scale. Higher scores indicated higher trait mindfulness. Sample items include: "I did jobs or tasks automatically without being aware of what I was doing" and "I found myself doing things without paying attention" (both reverse scored). Reliability for the five-item scale was $\alpha = 0.87$.

3.3.2. Stress appraisal

Participants completed a single item measure of perceived stress, namely: "How much stress are you experiencing right now?" This was rated to on a 1 (*not at all*)–7 (*very stressed*) scale. Perceived stress was measured immediately before the social threat procedure to control for baseline stress, 5 min after begin-

ning the stressful procedure to assess immediate reaction, and also at 30 min after the procedure to assess stress recovery.

3.3.3. Coping

To assess approach and avoidant coping, the *COPE inventory* (Carver, Scheier, & Weintraub, 1989) was assessed 30 min following the social threat procedure. Avoidant coping efforts included denial, behavioral disengagement, and mental disengagement (four items for each subscale). Approach coping efforts included active coping, acceptance, and positive reinterpretation and growth (four items for each subscale). Responses were scaled from 1 (*I did not do this at all*)–4 (*I did this a lot*). Internal consistency estimates for each subscale ranged from 0.61 to 0.73, average $\alpha = 0.68$). As in past research (e.g., Deisinger et al., 1996; Lyne & Roger, 2000; Stowell et al., 2001), the three subscales comprising each type of coping were averaged to form composite approach and avoidant scales ($\alpha = 0.82$ and 0.86 , respectively).

3.3.4. Anxiety

A five-item measure of anxiety was completed at baseline (pre-task) and 30 min after task engagement. Items were adapted from Wegner, Broome, and Blumberg (1997), and included *nervous*, *tense*, *anxious*, *relaxed*, and *calm* (latter two items are reverse scored). Responses were made on a 7-point scale (*not at all* to *very much*) with respect to how participants felt in the present moment. Reliability was high, average $\alpha = 0.90$.

3.3.5. Optimism

Participants responded to the 8-item Life Orientation Test (LOT Scheier & Carver, 1985) by agreeing or disagreeing on a scale of 1–4 items such as “I usually expect the best”. The LOT demonstrated acceptable reliability in the present study, $\alpha = 0.71$.

3.3.6. Neuroticism

The 10-item brief measure of the big-5 traits (Gosling, Rentfrow, & Swann, 2003) asks participants to use 7-point scales to rate themselves on adjectives reflecting neuroticism, extraversion, conscientious, openness, and agreeableness. We focused on neuroticism in particular ($r = 0.69$), to control for its known effects on stress and coping (e.g., Costa & McCrae, 1980).

3.3.7. Maze performance task

Eight moderately difficult mazes were provided to participants to assess capacity for concentration and creative thinking after the stressful task. Participants were given 5 min to complete as many mazes as they could, and instructed to, during this time, complete mazes in such a way that they do not take their pens off the page until finishing a given maze. Two coders recorded the number of correctly completed mazes, as well as errors made on each maze (number of maze $k = 0.98$; errors $k = 0.95$). Performance was computed with the formula: (# completed mazes $\times 4$) – (# errors). Scores ranged from 3 to 28 ($M = 14$).

4. Results

4.1. Preliminary analyses

Descriptive statistics on the study variables are presented in Table 1. *t*-tests showed no gender effects on the variables of interest (all p 's > 0.05). MAAS scores were at the normative college student level. As summarized in Table 1, perceived stress scores rose immediately following the manipulation, indicating that the task was successful in producing stress. Perceived stress declined but did not a return to baseline by the 30-min post-task point. Anxiety levels also rose from baseline to 30 min post-manipulation. Partic-

Table 1
Study 1 descriptive statistics and relations with mindfulness.

	<i>M</i>	<i>SD</i>	Mindful β
Mindfulness	4.89	0.83	–
Baseline stress response	2.89	1.21	–0.18*
2 m stress response	3.72	1.34	–0.29*
30 m stress response	3.34	1.56	–0.35*
Approach coping	2.89	0.80	0.05
Avoidance coping	2.44	0.74	–0.52**
Baseline anxiety	2.42	1.24	–0.17*
30 m anxiety	4.02	1.12	–0.28*
Optimism	3.92	0.92	0.24*
Neuroticism	2.53	1.26	–0.51**
Performance	14.09	4.72	0.39**

* $p < .05$.

** $p < .01$.

ipants made greater use of approach coping than avoidant coping to manage their responses to the stress encounter. Table 1 also shows that trait mindfulness predicted lower perceived stress, less avoidant coping, and less anxiety at each time point in this study.

Hierarchical ordinary least squares (multiple) regression analyses were conducted to assess the relation of trait mindfulness on stress and coping. Regression analyses also controlled for baseline stress. To explore whether mindfulness uniquely influenced these outcomes, analyses controlled for trait optimism and neuroticism (entered at step 1). Mindfulness was entered at step 2 so as to assess its unique contributions above and beyond those of optimism and neuroticism. Changes in r^2 reflect additional variance contributions of mindfulness to outcomes of interest.

4.2. Mindfulness and perceived stress

A regression analysis tested whether trait mindfulness predicted more adaptive stress appraisal (perceived stress) soon after the stress encounter, and after a recovery period, above and beyond effects of optimism and neuroticism. Results showed that trait optimism was highly predictive of both lower initial, $\beta = -0.44$, $p < 0.01$, and lower delayed stress response, $\beta = -0.31$, $p < 0.05$. Neuroticism, on the other hand, predicted substantially higher stress initially, $\beta = 0.39$, $p < 0.01$, and after 30 min, $\beta = 0.27$, $p < 0.05$. Controlling for these, MAAS mindfulness predicted lower perceived stress 5 min after the stress induction, $\beta = -0.31$, $p < 0.05$, and 30 min after the stress induction, $\beta = -0.39$, $p < 0.01$, accounting for 12% and 16% additional variance in stress response above and beyond that predicted by step 1 indicators. These analyses indicate that mindfulness predicted more benign initial and delayed cognitive appraisals of this stress encounter.

4.3. Mindfulness and coping

Hierarchical regression analyses showed that avoidant coping was associated with both neuroticism, $\beta = 0.36$, $p < 0.05$, and optimism, $\beta = -0.46$, $p < 0.01$ (approach coping was not related to either, β 's = 0.09–0.18, p 's > 0.10). Controlling for these, mindfulness predicted lower use of avoidant coping styles in response to the social threat task, $\beta = -0.54$, $p < 0.01$, accounting for 21% additional variance, but did not predict approach coping in response to the task, $\beta = 0.06$, $p > 0.10$. Thus, more mindful participants tended to engage in less avoidant coping in response to social threat, but not more approach coping.

4.4. Mindfulness and performance

Regression analyses indicated that neuroticism, $\beta = -0.33$, $p < 0.05$, but not optimism, $\beta = 0.14$, $p > 0.05$, predicted

performance. Above and beyond the effect of neuroticism, mindful participants performed more highly on the maze task, $\beta = 0.39$, $p < 0.01$, accounting for 15% additional variance in performance.

4.5. Mindfulness – anxiety mediation by stress processes

Baron and Kenny's (1986) guidelines for testing mediation were followed when assessing whether immediate cognitive appraisals (5 min after task) and coping strategies helped to explain levels of anxiety 30 min after the math task. First, controlling for baseline anxiety, mindfulness predicted lower anxiety responses 30 min after the stress manipulation, $\beta = -0.28$, $p < 0.05$. As described above, mindfulness predicted immediate stress responses. We expected that part of the anxiety reported 30 min after the stressful task would be due to perceived stress 5 min after the task and to more adaptive coping strategy use. We tested mediation effects only for avoidant coping styles, because mindfulness did not relate to approach coping in this study. Higher perceived stress at 5 min post-task was strongly associated with higher anxiety at 30 min, $\beta = 0.52$, $p < 0.01$, and avoidant coping predicted higher anxiety 30 min after the task, $\beta = 0.31$, $p < 0.05$. Mindfulness no longer predicted anxiety when perceived stress and avoidant coping were controlled, $\beta = -0.08$, $p > 0.50$. Sobel's test showed a significant mediation effect for both stress, $z = 2.03$, $p < 0.05$ and avoidant coping, $z = 1.95$, $p = 0.05$ for this model.

4.6. Mindfulness – performance mediation by stress processes

Similar mediation models were used to assess mediation for effects on performance by perceived stress at 5 min and avoidant coping at 30 min. Recall that mindfulness predicted higher performance on the maze task. Higher perceived stress at 5 min post-task predicted poor performance on the task, $\beta = -0.42$, $p < 0.01$, as did avoidant coping, $\beta = -0.25$, $p < 0.05$. Moreover, when accounting for these constructs, mindfulness no longer predicted performance, $\beta = 0.15$, $p > 0.05$. Sobel's test showed indirect effects for both stress, $z = 2.38$, $p < 0.05$ and avoidant coping, $z = 1.98$, $p < 0.05$.

5. Brief discussion

Study 1 demonstrated that more mindful individuals perceived less stress in immediate response to an induced social threat, as well as greater recovery 30 min later. More mindful individuals also reported less use of avoidant coping, although they did not report greater use of approach coping. These effects were present above and beyond the effects of neuroticism and optimism, indicating that mindfulness has unique effects not attributable to these constructs. Lower levels of perceived stress and less avoidant coping helped explain why more mindful individuals experienced lower anxiety, and performed highly 30 min after the threat task. These results lend support to the hypotheses of this study series by suggesting that mindfulness helps to lessen anxiety through more effective stress regulation. This study focused on responses to a specific laboratory stressor using a single well-being indicator. To begin to examine our hypotheses in naturalistic contexts, a short-term longitudinal study was conducted.

6. Study 2

Study 1 provided initial evidence in support of our hypotheses in a controlled laboratory environment. Study 2 was designed to test the external validity of our hypotheses concerning the effect of trait mindfulness on regulation processes, and the role of this regulation in explaining the higher levels of well-being among more mindful individuals. A short-term longitudinal design was

used, in which respondents first completed a measure of trait mindfulness, and then one month later completed measures of perceived stress, coping, and well-being over the past month. To broaden the investigation of well-being outcomes from those examined in Study 1, both positive and negative emotional and cognitive indicators were used. To test whether mindfulness would predict stress and coping above and beyond the effects of optimism and neuroticism in real-life, as well as laboratory settings, we assessed these as in Study 1. In addition in this study we controlled for socially desirable responding.

7. Method

7.1. Participants

Participants were 92 undergraduates (83% female) ranging in age from 18 to 31 ($M = 20$, $SD = 1.71$ years). The sample was 65% Caucasian, 19% Asian-American, 5% African-American, and 5% Hispanic. Six percent did not report race/ethnicity.

7.2. Measures

Trait optimism ($\alpha = 0.73$) and neuroticism ($r = 0.67$) were assessed as in Study 1.

7.2.1. Mindfulness

The full 15-item trait MAAS (Brown & Ryan, 2003) was administered at the onset of the study. Using a 1–6 (*almost always* to *almost never*) scale, participants responded to items including "I could be experiencing some emotion and not be conscious of it until some later time", and "It seems I am 'running on automatic' without much awareness of what I'm doing". Reliability (α) in this sample was 0.83.

7.2.2. Perceived stress

Participants were asked to report their most stressful event in the past month. They reported such events as school and job problems, romantic partner conflict, family difficulties, and chronic health difficulties. They were then asked, "How stressful was this event?" and responded on a 1 (*not at all*)–5 (*very stressful*) scale. As an additional indicator of perceived stress, the *Perceived Stress Scale* (PSS; Cohen et al., 1983; $\alpha = 0.84$) was used. Participants reported the degree to which they experienced stress over the past month using a 5-point scale (0 = *never* to 4 = *very often*). Items included "How often did you feel difficulties were piling so high that you could not overcome them?"

7.2.3. Coping strategies

The COPE inventory (Carver et al., 1989) was used as in Study 1. Internal consistency estimates for each subscale ranged from 0.60 to 0.71 (average $\alpha = 0.63$).

7.2.4. Well-being and ill-being

The *Positive and Negative Affect Schedule* (PANAS; Watson, Clark, & Tellegen, 1988) was used to assess affect over the past month. Participants reported how much they felt each of 20 adjectives reflecting positive affect (e.g., alert, proud, strong; $\alpha = 0.82$) and negative affect (e.g., scared, nervous, distressed; $\alpha = 0.80$) on 7-point scales (1 = *very slightly or not at all* to 7 = *extremely*). *Satisfaction with Life* was assessed using the five-item Satisfaction With Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985; $\alpha = 0.84$). The scale uses a 7-point scale ranging from 1 (*not at all*) to 7 (*true*) and included items referencing the past month (e.g., "I was satisfied with my life"). Depressive symptoms over the past month were assessed with the *Center for Epidemiological Studies*

Depression Scale (CES-D; Radloff, 1977; $\alpha = 0.88$): Twenty items assessed such symptoms as “I felt sad” and “I could not get going”. Positive affect and life satisfaction, $r = 0.53$, $p < 0.01$, were averaged to create a well-being composite, and negative affect and depression, $r = 0.80$, $p < 0.01$, were averaged to create an ill-being measure.

The *Balanced Inventory of Desirable Responding (BIDR; Paulhus, 1988)* was used to control for social desirability. The BIDR includes self-deceptive enhancement (SDE), impression management (IM), and self-deceptive denial (SDD) subscales. In the present study, only the SDE ($\alpha = 0.75$) and IM ($\alpha = 0.79$) subscales were included.

8. Results

Preliminary *t*-tests showed that women reported a higher number of stressors than men, $t(91) = 2.67$, $p < 0.01$. Additionally, in the present study older participants were higher in mindfulness, $r = 0.21$, $p < 0.05$. No other primary constructs (mindfulness, perceived stress, coping, or well-being) related to gender, $t's(91) = 0.01–2.08$, $p's > 0.10$, or age $r's = 0.03–0.15$, $p's > 0.10$. Descriptive analyses for mindfulness, stress modulation, stress indicators, and ill- and well-being are presented in Table 2.

To examine the predictive relation between mindfulness, stress, and response modulation strategy use, coping strategies (avoidant and adaptive) and stress (perceived stress and most stressful event) at time 2 was regressed onto mindfulness at time 1 using separate ordinary least squares (OLS) regression models. All analyses controlled for gender, socially desirable response tendencies, optimism, and neuroticism at step 1. Mindfulness was entered in the second step.

8.1. Perceived stress

To thoroughly explore the effects of mindfulness on stress, we tested its effects on each stress indicator, separately. At step 1, optimism, neuroticism, and biased responding related to less perceived stress and less stressfulness of events, $\beta's = \pm 0.18–0.45$, $p's < 0.05$. As predicted, above and beyond these effects, mindfulness predicted less perceived stressfulness of events, $\beta = -0.32$, $p < 0.01$, $\Delta r^2 = 0.11$, and less perceived stress at time 2, $\beta = -0.40$, $p < 0.01$, $\Delta r^2 = 0.13$ (composite $\beta = -0.40$, $p < 0.01$, $\Delta r^2 = 0.13$).

8.2. Coping strategies

Regression results showed that optimistic individuals used more approach coping, and less avoidant; while those high in neuroticism used fewer approach and more avoidant coping strategies, $\beta's = \pm -0.22–0.39$, $p's < 0.05$. Above and beyond these effects, and those of biased responding, MAAS mindfulness predicted more

adaptive coping strategy use, both in terms of more approach coping over one month, $\beta = 0.23$, $p < 0.05$, and less use of avoidant coping, $\beta = -0.27$, $p < 0.05$.

8.3. Mindfulness – well-being mediation by stress processes

Correlations showed that the two stress indicators related highly to one another, $r = 0.72$. Therefore, we averaged both to construct a perceived stress composite with which to test mediations for well-being.

The following analyses were conducted predicting the effects of month 1 mindfulness at on month 2 ill-being outcomes: negative affect and depression, and well-being outcomes: positive affect and life-satisfaction. We then tested multiple mediation by a stress composite, adaptive coping, and avoidance coping.

Mindfulness predicted ill-being one month later, $\beta = -0.40$, $p < 0.01$, as did the stress composite, $\beta = 0.53$, $p < 0.01$ and avoidance coping, $\beta = 0.33$, $p < 0.01$. Approach coping styles did not predict negative affect, $p > 0.05$. Stress and avoidance coping fully mediated the effects of mindfulness, $\beta = -0.07$, $p > 0.05$. Sobel's test for indirect effect was $z = 2.35$, $p < 0.05$ for stress and $z = 2.03$, $p < 0.05$ for coping.

Additionally, mindfulness predicted well-being one month later, $\beta = 0.34$, $p < 0.01$, as did the stress composite, $\beta = -0.29$, $p < 0.05$ and approach coping, $\beta = 0.32$, $p < 0.05$. Avoidant coping styles did not predict well-being, $p > 0.05$. In turn, stress and approach coping fully mediated the relation between mindfulness and positive affect, $\beta = 0.18$, $p > 0.05$. The indirect effects for stress and coping were marginally present; respectively, $z = 1.80$, $p < 0.08$ and $z = 1.95$, $p = 0.05$.

9. Brief discussion

The findings of Study 2 provided initial support for the external validity of our two central hypotheses. In accord with the first hypothesis, mindfulness predicted lower perceived overall stress, lower perceived event-related stress, and the perception of fewer stressors. Moreover, results indicated that individuals higher in mindfulness made greater use of adaptive coping strategies over a one-month period, reflected in lower use of avoidance coping and higher use of approach coping with stressful experiences. Supporting the second hypothesis, mediation analyses showed that the higher levels of adaptive coping among more mindful individuals fully mediated the temporal relations between mindfulness and well-being, using both positive and negative indicators. These relations were found after controlling for respondent gender and socially desirable response biases.

These findings are promising in showing that mindfulness has salutary effects on stress and response modulation reflected in coping styles and well-being, but the study was limited by its reliance on retrospective reports of subjective experiences. To correct this methodological deficiency, Study 3 was conducted to examine the relations between mindfulness, perceived stress, coping styles, and well-being in individuals' lives on a day-to-day level. Having shown that these effects are present even when controlling for optimism and neuroticism, both in lab and life settings, we do not examine these constructs in the present study.

10. Study 3

Study 3 was designed to extend the findings of the previous studies by examining the relation of mindfulness to stress processes and well-being at the level of day-to-day experience. To do so, we used an ecological momentary assessment (EMA) approach, which seeks to capture experiences *in vivo* and without

Table 2
Study 2 descriptive statistics and relations with mindfulness.

	<i>M</i>	<i>SD</i>	Mindful β
Mindfulness	4.32	0.74	–
Perceived stress	2.98	0.55	–0.42**
Most stressful event	2.73	0.43	–0.33**
Approach coping	3.63	0.56	0.22*
Avoidance coping	3.85	0.67	–0.28*
Ill-being	2.89	1.21	–0.40**
Well-being	3.72	1.34	0.34**
Optimism	3.71	0.87	0.29*
Neuroticism	2.65	1.14	–0.57**

Note: Mindfulness was measured at month 1. Stress indicators, coping, and well-being indicators were measured at month 2.

* $p < 0.05$.
** $p < 0.01$.

undue influence from retrospective memory and other biases that can limit one-occasion reports (Brown & Ryan, 2007; Stone & Shiffman, 1994). This approach can provide a window into subjective experience and behavior close to the time it happens in individuals' lives. It also permits study of the dynamic relations between psychological phenomena over time (Todd, Tennen, Carney, Armeili, & Affleck, 2004).

A two-pronged EMA strategy was used to assess day-to-day mindfulness, stress appraisals, coping, and well-being over a 7-day period. Using experience sampling, individuals reported on the quality of their mindful attention at the time they were paged (three times a day). Use of this state measure, together with a measure of trait mindfulness collected at the beginning of the study, allowed us to test whether both the prevailing quality of individuals' attention (trait mindfulness) and their momentary fluctuations in attentional quality (state mindfulness) were predictive of stress appraisals, coping, and well-being, as measured with end-of-day sampling of each day's events and experiences. To test the generality of the findings concerning stress processes and well-being, a different combination of measures than those included in the previous studies were used.

11. Method

11.1. Participants

Participants were 70 students (21 men, 49 women) aged 18–40 years ($M = 20$, $SD = 1.84$). The racial/ethnic composition of the sample was 65% Caucasian, 13% Asian-American, 7% African-American, 5% Hispanic, and 10% reported other ethnicities.

11.2. Procedure

Participants attended a briefing and EMA training session 12–24 h before beginning the EMA portion of the study. At this session, they completed individual difference measures, were given pagers, and were instructed on EMA procedures. For 7 days following this session, participants were paged at quasi-random intervals three times per day, between the hours of 10 am and 11 pm. At each page, they completed a five-item state MAAS referencing their experience immediately before each signal. Each night before going to bed, participants also completed the stress process and well-being measures with respect to the present day.

11.3. Measures

11.3.1. Mindfulness

In the initial session, participants completed the 15-item trait MAAS ($\alpha = 0.88$). To assess state mindfulness, the five-item state version of the MAAS (Brown & Ryan, 2003) was completed three times a day on a quasi-random schedule, upon receipt of a pager signal.

Stress appraisals were assessed with two end-of-day measures. First, participants were asked to list the most stressful event of the day. Frequent responses concerned academic issues, romantic relationship difficulties, and family conflicts. They then responded to this question: "How stressful or traumatic was this event?" on a scale of 1 (*not at all*)–7 (*very stressful*). Second, a single item asked: "How much stress did you experience today?" using a 1 (*not at all*)–7 (*very much*) scale. These items were highly correlated ($r = 0.76$); therefore, we constructed a single stress appraisal composite from them when testing mediations. When assessing direct effects of mindfulness, we analyzed each, separately, to best understand the impact of mindfulness on stress.

11.3.2. Coping strategies

To assess daily coping strategies, participants completed relevant subscales of the COPE inventory with respect to the stress they had experienced on each day of the study. As in Studies 1 and 2, six subscales were completed: denial, behavioral disengagement, mental disengagement (all avoidant forms of coping), and active coping, acceptance, and positive reinterpretation and growth (approach forms of coping). Cronbach's alphas for the subscales ranged from 0.63 to 0.76 ($M = 0.68$).

11.3.3. Well-being

To measure well-being, we collected several indicators. First, positive and negative affect were assessed using a nine-item affect valence measure (Diener & Emmons, 1984). Positive affect (PA) items were: *joyful*, *happiness*, *pleased*, and *enjoyment/fun* ($\alpha = 0.77$). Negative affect (NA) items were: *worried/anxious*, *depressed*, *frustrated*, *angry/hostile*, and *unhappy* ($\alpha = 0.88$). Second, we used the *Subjective Vitality Scale* (SVS; Ryan & Frederick, 1997; $\alpha = 0.88$). The SVS assesses the experience of feeling energized and fully alive. Participants completed three of the most conceptually representative items from the seven-item SVS: "Today, I felt alive and vital", "Today, I had energy and spirit", and "Today, there were times that I felt so alive I just wanted to burst". Because subjective vitality and positive affect correlated $r = 0.68$, we averaged these two constructs to create a single well-being variable.

11.3.4. Data analytic strategy

Hierarchical linear modeling (HLM, Raudenbush & Bryk, 2002) was used to accommodate the nested nature of the data. MAAS mindfulness and gender were defined at level 2 (person-level), while state MAAS averaged over the three assessments each day, and end-of-day perceived stress, coping, and well-being reports were defined at level 1 (day-level). Unconditional models were first tested to determine whether sufficient variance existed to test between- and within-participant effects on each outcome. Using the intraclass correlation (ICC) for each outcome as an indicator these effects, the models showed that across outcomes, 51–77% of the total variance occurred between persons, while 23–49% of the variance occurred within persons. Given the substantial variance accounted for at each level, full level 1 and 2 models were tested.

Across analyses, the general level 1 equation was as follows:

$$OV_{ij} = \beta_{0j} + \beta_1 X_{1ij} + \beta_2 X_{2ij} + e_{ij}$$

where β_{0j} reflects the intercept or the average perceived stress, coping, or well-being outcome; β_1 reflects the estimated population slope of state mindfulness; β_2 reflects the day of the week, and e_{ij} represents level 1 error.

At level 2, we controlled for gender and trait mindfulness when assessing the level 1 outcomes of interest. The level 2 equation was:

$$\beta_{0j} = G_{00} + G_{01} X_{1j} + G_{02} X_{2j} + u_{0j}$$

where G_{00} reflects the day-level intercept for an average person; G_{01} refers to the effect of trait mindfulness; G_{02} reflects the slope for gender, and u_{0j} is error at level 2. As Bryk and Raudenbush (1992) recommended, level 1 variables were centered on individual rather than sample means, and level 2 variables were sample-mean centered.

12. Results

Preliminary t -tests indicated that women reported lower daily well-being, $t(525) = 6.80$, $p < 0.01$. Additionally, older participants were higher in state mindfulness, $r = 0.21$, $p < 0.05$. Gender and

age were unrelated to the other variables in the study, all p 's > 0.05. Descriptive statistics for all study variables, and direct relations with state and trait mindfulness, are shown in Table 3.

Preliminary HLM analyses also showed that across outcomes, trait mindfulness did not interact with state mindfulness; that is, the effects of state mindfulness on the outcomes were similar for more and less dispositionally mindful individuals, p 's > 0.10. Thus, these independent variables were treated as main effects only.

12.1. Mindfulness and perceived stress

To best understand the relation between mindfulness and stress, we analyzed the direct effects predicting each of the three stressors, separately. HLM analyses showed that higher trait mindfulness predicted lower appraisals of both stress for daily events, $\beta = -0.34, p < 0.01$ and perceived daily stress, $\beta = -0.29, p < 0.05$. Further, on days in which individuals were more mindful, they also experienced lower stress appraisal for daily stressors, $\beta = -0.31, p < 0.01$, and less perceived stress, $\beta = -0.28, p < 0.05$.

12.2. Mindfulness and coping strategy use

Higher trait mindfulness predicted more adaptive coping at the daily level, as reflected in more approach coping strategy use, $\beta = 0.21, p < 0.05$, and less avoidant coping strategy use, $\beta = -0.22, p < 0.05$. Further, on days in which individuals were more (state) mindful, they tended to use more adaptive coping strategies, again reflected in more approach coping, $\beta = 0.20, p < 0.05$, and less avoidant coping, $\beta = -0.42, p < 0.01$.

12.3. Mindfulness – well-being mediation by perceived stress and coping responses

To test our hypothesized mediation model in HLM, we followed Kenny, Korchmaros, and Bolger (2003). Two models were constructed to test the direct relations of trait and state mindfulness to indicators of well-being (positive affect and vitality) and ill-being (negative affect) separately. To test for mediation by stress appraisals, approach coping and avoidance coping, models that included these variables were examined for their role in explaining relations between trait and state mindfulness and well-being. Results appear in Table 3.

Trait mindfulness predicted higher day-to-day well-being, $\beta = 0.46, p < 0.01$. State mindfulness was also related to higher daily well-being $\beta = 0.32, p < 0.05$. In separate models, daily perceived stress predicted lower well-being, $\beta = -0.31, p < 0.01$. Approach coping strategy use positively predicted well-being, $\beta = 0.19, p < 0.01$, but avoidant coping did not, $p > 0.30$.

With perceived stress and coping included in a model testing the relation of trait and state mindfulness to well-being, the relation of trait mindfulness to well-being became non-significant,

$\beta = 0.11, p > 0.05$, as did the relation of state mindfulness, $\beta = 0.10, p > 0.10$. These analyses indicate that the relation of both trait and state mindfulness to well-being was mediated by lower stress appraisals and more adaptive coping strategy use on a daily basis. Sobel's test for indirect effect demonstrated mediation by stress, $z = 7.12, p < 0.01$, and approach coping, $z = 2.02, p < 0.05$ for trait mindfulness. Additionally, an indirect effect was present for state mindfulness: by stress, $z = 3.01, p < 0.01$, by approach coping, $z = 2.58, p < 0.05$.

Daily ill-being was predicted by both state, $\beta = -0.44, p < 0.01$, and trait, $\beta = -0.38, p < 0.01$ mindfulness. Daily stress also predicted higher ill-being, $\beta = 0.52, p < 0.01$, as did approach coping, $\beta = -0.18, p < 0.01$ (but not avoidant coping, $p > 0.50$). These effects partially mediated those of trait mindfulness, $\beta = 0.13, p < 0.01$, and fully those of state mindfulness, $\beta = 0.04, p > 0.05$. Sobel's test demonstrated an indirect effect present at the trait level: stress $z = 4.83, p < 0.01$, approach coping, $z = 2.06, p < 0.01$; and state level: stress $z = 3.02, p < 0.01$, approach coping marginal effect, $z = 1.82, p < 0.07$.

13. Brief discussion

The results of this study demonstrated that more mindful individuals were less likely to appraise their day-to-day experiences as stressful. Such individuals also used more approach coping and less avoidant coping strategies to deal with daily stress experiences. The benefits of mindfulness for stress processing also appeared at the daily level, in that more frequent mindful states during the day were related to lower stress appraisals and more adaptive coping. As in previous research (Brown & Ryan, 2003), the effects of trait and state mindfulness were independent, suggesting that the beneficial effects of state mindfulness were not limited to those with a more mindful disposition, although as in the same previous research, those higher in trait mindfulness were more likely to report mindful states on a day-to-day basis.

Supporting our second hypothesis, mediation analyses demonstrated full mediation of the relations between trait mindfulness and well-being. Specifically, because they reported lower stress appraisals (perceived stress) and engaged in more adaptive coping, more mindful individuals experienced higher daily well-being. Also, on days in which they were more mindful (state mindfulness), individuals experienced higher well-being, in part because their stress appraisals were more benign and because they used more adaptive coping strategies.

These findings are consistent with the results of Studies 1 and 2, though each used a different study design and mix of measures. Thus this study provides further support for the claim that mindfulness conduces to more adaptive stress processing and, in turn, higher well-being on a day-to-day basis. A final study was conducted to bridge the findings of the specific laboratory stress experience of Study 1 with the findings on the general, naturalistic stress experiences of Studies 2 and 3.

14. Study 4

In this final study, our hypotheses were tested in the context of a specific real-world challenge. Specifically participants were first-semester college freshmen facing the demands of a college course. The adjustment to college is often a stressful one (e.g., Ross, Niebling, & Heckert, 1999), and thus represents an appropriate context within which to examine our hypotheses concerning the predictive role of mindfulness in positive stress appraisal and coping responses. This study examined these processes within a single course so that the prediction of responses to specific academic

Table 3
Study 3 descriptive statistics and relations with mindfulness.

	M	SD	Trait mindful β	State mindful β
Trait mindfulness	4.14	0.95	–	0.57**
State mindfulness	4.12	1.92	0.57**	–
Stress response	4.18	1.60	–0.34**	–0.29*
Approach coping	2.99	1.03	0.21*	0.20*
Avoidance coping	2.43	1.13	–0.22*	–0.42**
Efficacy for modulation	3.25	1.02	0.35*	0.49**
Ill-being	3.37	1.12	–0.38**	–0.44**
Well-being	4.62	1.15	0.46**	0.32*

* $p < 0.05$.

** $p < 0.01$.

challenges could be studied at the time of their occurrence. Aside from providing an investigation of specific, *in vivo* stress-related experiences, this study was also designed to replicate and extend the study of appraisal processes and coping strategies that more mindful individuals may utilize. In particular, a more fine-grained analysis of cognitive appraisal was undertaken by examining challenge and threat construals and emotions accompanying them.

A semester-long longitudinal design was used in which the hypotheses were tested at two high-stress time points in the academic semester – at midterm and term end. This dual test was considered important because the relations may differ between these time points. For example, coping efforts may become more prevalent later in the semester when, as might be expected, perceived stress levels are higher.

15. Method

15.1. Participants

Participants were 141 undergraduates (65 men, 76 women) ranging in age from 17 to 19 years ($M = 18$, $SD = 0.69$). Most (69%) were Caucasian, 17% were Asian, 7% were Hispanic or Latino(a), 4% were African-American, and 3% reported another race or ethnicity. All were first-semester college freshmen enrolled in an introductory course in psychology. Some were lost to study dropout at time points 2 ($n = 24$) and 3 ($n = 20$). Analyses using *t*-tests and chi-square tests showed that study non-completers did not differ from completers on any demographic or psychological variables at time points 2 and 3, all p 's > 0.05 .

15.2. Procedure

Participants completed measures at three points during the Fall academic semester. At the beginning of academic term (time 1), a measure of mindfulness was completed, along with other study measures. In the final 1–2 days before the midterm course test (time 2), measures of state mindfulness, examination stress appraisal, coping responses, and current well-being were collected, along with several measures of test preparation. Finally, in the 1–2 days before the final course test at semester end (time 3), the same measures taken at time 2 were completed. The time interval between each assessment point was approximately 6 weeks.

15.3. Measures

15.3.1. Mindfulness

The 15-item trait MAAS (Brown & Ryan, 2003) was completed ($\alpha = 0.85$). In addition, the state measures used the previously described five-item state MAAS.

15.3.2. Cognitive appraisal

To assess appraisals of the upcoming exam, two measures were completed. First was McGregor and Elliot's (2002) 10-item measure of challenge construal ($\alpha = 0.78$) and threat construal ($\alpha = 0.83$). Items were worded to refer to the upcoming test (e.g., "I think the exam represents a positive challenge for me"; "I believe the exam could have negative consequences for me"). Responses were made on a 1(*not at all true for me*)–7(*very true for me*) scale. A six-item measure of challenge affect (*eager, hopeful, confident*; $\alpha = 0.58$) and threat affect (*worried, fearful, anxious*; $\alpha = 0.86$) (Folkman & Lazarus, 1985) was also completed in reference to the upcoming test. Responses were made on a 0(*not at all*)–4(*a great deal*) scale. Because moderate-to-high correlations were found between the two measures of challenge ($r = 0.45$, $p < 0.01$) and the two measures of threat ($r = 0.73$, $p < 0.01$), they

were combined to form composite measures of challenge and threat appraisal after first centering the scores on each original measure.

15.3.3. Coping

We employed the COPE inventory (Carver et al., 1989), as in the previous studies. Responses were made on a 1(*I have not been doing this at all*)–4(*I have been doing this a lot*) scale and referenced the "past several days and presently". As in the previous studies, scores on subscales of approach coping ($\alpha = 0.88$) and avoidant coping ($\alpha = 0.87$) were averaged.

15.3.4. Ill-being

The sadness ($\alpha = 0.91$) and anxiety ($\alpha = 0.85$) subscales of the Profile of Mood States (McNair, Lorr, & Droppleman, 1971) were used to assess ill-being, and referenced the "past several days, including today". Responses were made on a 0(*not at all*)–4(*extremely*) scale. Since the two subscales were highly correlated ($\alpha = 0.80$, $p < 0.01$) they were combined into a composite ill-being measure after first centering the subscale scores.

Finally, course test scores for all participants were obtained to control for the effect of previous test results on appraisals, coping strategy use, and current well-being. At time 2 of the study, participants were about to take their second course test. At time 3, the fourth test was about to be taken. In the following analyses, we controlled for the potential effects of the immediately prior test score (test 1 at time 2, and test 3 at time 3).

16. Results

Descriptive statistics and relations with mindfulness at time points 2 and 3 are shown in Table 4. Trait mindfulness assessed at the beginning of the academic term predicted lower threat appraisals at both midterm and at the end of term, but did not predict higher challenge appraisals. Higher mindfulness also predicted lower avoidance coping in the days leading up to the two exams, but not more approach coping. Finally, paralleling results of the previous three studies, trait mindfulness predicted higher well-being at both time points. In the interest of preserving statistical power and examining differential relations at the two testing points, the data were analyzed at time points 2 and 3 separately. Gender and ethnicity were not predictive of the outcomes in preliminary analyses so were not further considered.

Table 4
Study 4 descriptive statistics and relations with mindfulness.

	<i>M</i>	<i>SD</i>	Mindful β
Mindfulness	4.08	0.70	–
<i>Time 2 scores</i>			
Previous test score	26.75	4.48	0.15
Cognitive appraisal – challenge	2.95	0.86	0.17*
Cognitive appraisal – threat	3.34	1.18	–0.29**
Approach coping	10.47	2.44	0.01
Avoidance coping	3.49	0.94	–0.34**
POMS well-being	12.71	9.07	–0.35**
<i>Time 3 scores</i>			
Previous test score	27.41	7.81	–0.11
Cognitive appraisal – challenge	3.34	0.93	–0.05
Cognitive appraisal – threat	3.01	1.21	–0.16
Approach coping	10.62	2.08	–0.14
Avoidance coping	3.38	0.91	–0.22*
POMS well-being	13.01	8.96	–0.40**

* $p < 0.10$.

* $p < 0.05$.

** $p < 0.01$.

16.1. Mindfulness, threat appraisal, and coping

To assess the predictive relation between time 1 mindfulness and time 2, pre-midterm test appraisals and coping strategy use, separate ordinary least squares (OLS) regression models were tested, after controlling for the previous (first) test score. These regression results showed that time 1 MAAS mindfulness predicted lower threat appraisal at time 2, $\beta = -0.25$, $p < 0.01$ after controlling for test 1 score, which also inversely predicted threat appraisal in this model, $\beta = -0.27$, $p < 0.01$. Time 1 mindfulness also strongly predicted less use of avoidant coping at time 2, $\beta = -0.35$, $p < 0.01$. Previous exam score did not predict avoidant coping at time 2, $\beta = -0.02$, $p > 0.83$.

The same analytic strategy was used to assess the temporal relation between time 1 mindfulness and time 3 threat appraisal and coping. Multiple regression found that mindfulness predicted lower threat appraisal, $\beta = -0.20$, $p < 0.05$, after controlling for the most recent test scores, $\beta = -0.35$, $p < 0.01$. Time 1 mindfulness also predicted less avoidant coping at semester end, $\beta = -0.24$, $p < 0.05$, after controlling for previous test scores, $\beta = -0.16$, $p > 0.12$.

16.2. Mindfulness – well-being mediation by threat appraisal and coping

Multiple regression showed that time 1 mindfulness strongly predicted higher pre-test ill-being at time 2, reflected in lower levels of the anxiety/sadness composite, $\beta = -0.35$, $p < 0.01$. In this model, test 1 scores also predicted lower ill-being, $\beta = -0.18$, $p < 0.05$. To test whether more adaptive stress processing mediated the relation between time 1 mindfulness and time 2 well-being, the well-being composite was regressed on mindfulness, threat appraisal, avoidant coping, and for control purposes, test 1 scores. In this model, the effect size for time 1 mindfulness dropped to $\beta = -0.21$, $p < 0.01$. The relation of threat appraisal to well-being was also significant ($\beta = 0.49$, $p < 0.01$) while the effects of avoidant coping and test 1 score were non-significant in this model, both p 's > 0.61 . To test whether the partial mediation effect of threat appraisal was significant, two tests recommended by Mackinnon, Lockwood, Hoffman, West, and Sheets (2002) were performed. Both tests showed that threat appraisal partially mediated the temporal relation between mindfulness and pre-midterm test well-being, $z' = 2.55$, $p < 0.05$ and $P = 16.24$, $p < 0.01$.

The effect of stress processing as a mediator between time 1 mindfulness and time 3 well-being was tested in a parallel fashion. First, mindfulness strongly predicted higher well-being at semester end ($\beta = -0.46$, $p < 0.01$) after controlling for previous test scores ($\beta = -0.15$, $p > 0.12$). After the inclusion of time 3 threat appraisal and avoidant coping, the effect for mindfulness dropped to $\beta = -0.25$, $p < 0.01$. In this model, both threat appraisal and avoidant coping were inversely related to well-being, $\beta = -0.39$, $p < 0.01$, and $\beta = -0.29$, $p < 0.01$, respectively. The effect of test 3 scores was non-significant, $p > 0.77$. Indirect effects were significant for both threat appraisal ($z' = 1.90$, $p < 0.01$ and $p = 10.88$, $p < 0.01$) and avoidant coping ($z = 1.85$, $p < 0.05$ and $p = 6.94$, $p < 0.01$), indicating that the effect of mindfulness on well-being just before the final course test was partially mediated by both forms of stress processing.

17. Brief discussion

The results of this study extended the findings of the previous studies in two ways. First, a specific, real-life stress-relevant situation was studied to show that mindfulness predicted adaptive stress processing, and that such processing helped to explain the

temporal relation between mindfulness and well-being. Second, the study captured stress processes right in the midst of the academic stress situation – that is, within several days of two course tests. In particular, this feature permitted the study of anticipatory cognitive appraisals (challenge and threat), and in so doing suggested that more mindful individuals appraise future events more benignly, not just events that have recently occurred, as shown the previous studies in this series. This suggests that the higher well-being of more mindful individuals may be due in part to their tendency to appraise future situations in non-threatening ways, before coping efforts are required, as well as to the lesser use of avoidant coping strategies.

18. General discussion

The experiential mode of processing exemplified by mindfulness has been a perennial element in a number of schools of philosophical thought, but only in the last 25 years has mindfulness and its effects been subject to scientific inquiry (e.g., Brown & Ryan, 2003; Kabat-Zinn, 1990). Much of that work has been devoted to examining the beneficial psychological and physical outcomes of mindfulness and of interventions designed to enhance it (see Baer, 2003; Brown et al., 2007; Grossman et al., 2004 for reviews). The present findings add further support to the thesis that mindfulness conduces to well-being, manifest here in lower levels of mental health symptoms and higher levels of positive psychological experience.

Yet to date little work has investigated the processes through which these salutary effects occur. Adaptive stress processing, including more benign cognitive appraisals of stress situations and adaptive coping with stress, is considered a key underpinning for mental health and well-being (Gross & Munoz, 1995; Lazarus & Folkman, 1984) and the present studies were designed to test whether the well-being benefits of mindfulness could be explained, in part, by adaptive stress processing. Using a variety of methodological designs and measures, all four studies found that more mindful individuals were likely to view demanding situations as less stressful or threatening. More mindful individuals were also more likely to cope with stress in adaptive ways, particularly using less avoidant-oriented strategies in stress situations. Moreover, Studies 1 and 2 showed that both in laboratory and real-life settings, mindfulness effects were present above and beyond those of optimism and neuroticism. The results of these studies indicated that in general, both forms of stress processing helped to explain why mindfulness was related to higher psychological well-being, and, in Study 1, to higher performance.

The first three studies reported here were consistent in showing that mindfulness predicted lower stress perceptions, while Study 4 suggested that this relation may be specific to lower threat, rather than higher challenge appraisals. These findings are consistent with past research that has found an inverse relation between mindfulness and perceived stress (e.g., Baer et al., 2006) and with experimental and brain imaging research that has shown mindfulness to predict more benign social threat responses (see Brown, Ryan, Creswell, & Niemiec, 2008 for review). In the present research, the results on coping varied, in that mindfulness predicted more approach coping in Studies 2 and 3, and less avoidant coping in Studies 1 and 4. These inconsistent findings on coping may be attributable in part to the nature of the studies. For example, the two studies in which mindfulness did not predict approach coping – laboratory-based social threat and academic performance threat – were those in which two of the components of approach coping, namely acceptance and positive reinterpretation and growth, were less relevant than in the day-to-day contexts in which both threat and harm/loss experiences could be expected to occur. We can

tentatively conclude that mindfulness appears to foster more effective stress processing through cognitive appraisal and coping, but that the particular forms of coping strategy use may vary from one context to another.

These findings contribute to the incipient body of literature indicating that mindfulness appears to facilitate stress processing. This extant research has indicated that mindfulness predicts lower emotional reactivity to threatening situations (e.g., Arch & Craske, 2006; Creswell et al., 2007) and predicts quicker recovery from unpleasant emotional states such as sadness (Broderick, 2005). The present research is convergent with this work and further, points to specific processes that may help to explain the more effective regulatory responses associated with mindful processing in laboratory and naturalistic contexts.

The findings of the present studies have several implications. First, processing of stress-relevant situations is a central feature in individuals' day-to-day lives and these findings suggest that the way in which attention is brought to bear on events and experiences may be important to the adaptive regulation of emotions. Indeed, the deployment of attention is thought to be an important feature of emotional response modulation (Gross & Thompson, 2007), but to date, the study of attention has been focused on uses that have limited value, such as distraction, or are generally maladaptive, such as rumination. Further study of mindfulness may help to better disclose how the quality of attention that is deployed can have adaptive emotion regulatory advantage. Second the findings suggest that mindfulness conduces to more adaptive coping strategies within demanding situations. This may suggest that mindful persons may be less prone to avoidant strategies that take them away from the present moment, and/or have more awareness or access to positive problem-solving strategies. Which of these is more salient may be situation dependent, as across the four studies different types more adaptive coping emerged.

18.1. Limitations and future research

These studies were limited in several ways. First, the studies were non-experimental in design, limiting the ability to make causal inferences about the role of mindfulness in stress processing and well-being. All of the studies reported here established a temporal relation between mindfulness and the outcomes, and there is evidence from randomized, controlled studies that short-term mindfulness induction and longer-term mindfulness enhancement ameliorates stress and ill-being (Brown et al., 2007). But experimental studies will be required to demonstrate the specific causal chain of relations investigated here. Second, the present studies tested hypotheses with college students only. Undoubtedly college life is often stressful, but tests of the generality of the present findings to community adults is needed before firmer conclusions about the role of mindfulness in stress processing and well-being can be drawn.

Notably, the present research demonstrated effects of mindfulness using the MAAS, which has been shown, in a recent study, to reflect one of several possible facets of mindfulness; namely, acting with awareness (Baer et al., 2006). Other proposed facets of mindfulness, including nonreactivity to inner experience, observing and attending to sensations and thoughts, and describing or labeling with words (Baer et al., 2006), may differently relate to stress and coping. Although it is quite possible that, as these facets reflect a shared underlying phenomenon, they relate similarly to these constructs, future research examining their relations would be beneficial.

As alluded to already, there are a number of avenues for further research in this area. One of those is to examine a wider range of adaptive emotional response modulation strategies that mindfulness may help to foster. The most "forward-looking" strategy is sit-

uation selection – acting in ways that enhance the likelihood of entering situations that give rise to desirable (or fewer undesirable) emotions (Gross & Thompson, 2007). There is suggestion that mindfulness may conduce to a more careful selection of situations. On a theoretical level, mindfulness concerns a greater attention to the facts about past and present situations (e.g., Bishop, 2002), a quality that may better equip individuals to select situations with attention to their potential emotional consequences. Some evidence for this comes from two experience sampling studies (Brown & Ryan, 2003) showing that those higher in trait mindfulness engaged in more volitional, or self-endorsed activities on a day-to-day basis that were related to higher emotional well-being. With a higher prevalence of self-endorsed activity, more mindful individuals may also be exposed to fewer stressors over time, providing additional support for well-being.

More research is also needed on cognitive appraisal strategies. These studies showed a tendency of more mindful individuals to perceive events and situations as less stressful, and one study (Study 4) in the present series suggested that a lower incidence of threat appraisals in particular was an important mediator of the mindfulness – well-being relation. Use of other strategies deserves study, but investigation of both situation selection and appraisal is particularly important because these can both help to sidestep unpleasant emotional reactions and the consequent need to modulate, or cope with, those emotional responses. Study of such processes may be important not only for normative experiences, but also in predicting reactions to traumatic events. For example, the study of individual differences in mindfulness may prove important to understanding variations in emotional and syndromal trajectories following traumatic experiences. It is our hope that the present research will help to spawn further investigation of the ways in which mindfulness can facilitate effective stress processing as a means to enhance mental health and well-being.

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