Empirical Research Paper

Personality and Social Psychology Bulletin
1–14

DOI: 10.1177/0146167220956898
journals.sagepub.com/home/pspb
SAGE

Facing the Facets: No Association Between Dispositional Mindfulness Facets and Positive Momentary Stress Responses During Active Stressors

Thomas L. Saltsman[1], Mark D. Seery[1], Deborah E. Ward[1], Tracy M. Radsvick[1], Zaviera A. Panlilio[1], Veronica M. Lamarche[2], and Cheryl L. Kondrak[1]

Abstract

Mindfulness has been associated with enhanced coping with stress. However, it remains unclear how dispositional mindfulness impacts the nature and valence of experiences *during* active stressors. Across 1,001 total participants, we used cardiovascular responses from the biopsychosocial model of challenge/threat to assess the degree to which individuals cared about a stressor in the moment and had a positive versus negative psychological experience. Although we found a small association between mindfulness—particularly the acting with awareness facet—and responses consistent with caring more about the stressor (i.e., greater task engagement), we found no evidence that mindfulness was associated with exhibiting a more positive psychological response (i.e., greater challenge) during the stressor. Despite no differences in the valence of momentary experiences as a function of mindfulness, individuals higher in mindfulness self-reported more positive experiences afterward. These findings suggest that dispositional mindfulness may benefit responses to active stressors only after they have passed.

Keywords

dispositional mindfulness, stress and coping, cardiovascular responses, psychophysiology, biopsychosocial model of challenge/threat

Received November 19, 2019; revision accepted August 15, 2020

It can be easy for modern life to seem overwhelmingly stressful. In such times, it is broadly assumed that being mindful, or "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Kabat-Zinn, 1994, p. 4), will benefit coping responses. Indeed, in research findings, reporting high dispositional mindfulness has been associated with attenuated physiological reactions to stress (Brown et al., 2012; Bullis et al., 2014; Hertz et al., 2015; Laurent et al., 2013) as well as more adaptive cognitive responses (e.g., less rumination and pain catastrophizing) and greater psychological well-being (for reviews, see Keng et al., 2011; Tomlinson et al., 2018). Specific facets of mindfulness—particularly those related to nonjudgmental acceptance of one's experiences and awareness of one's action in the moment—have been argued to be especially important in shaping these positive responses (Brown et al., 2012; Soysa & Wilcomb, 2015; Stanley et al., 2019).

Although much research touts these seemingly unambiguous stress and coping benefits of dispositional mindfulness, it remains unclear how it impacts the specific nature and valence of individuals' experiences *during* active stressors, in which people must work to reach valued goals (e.g., tests, speeches, interpersonal interactions). For instance, if dispositional mindfulness predicts attenuated responses during stress, it could theoretically reflect either a relatively positive psychological experience (e.g., feeling capable) or simply not caring about the situation (e.g., "not sweating the small stuff"). Importantly, these responses would suggest different psychological processes and consequences. To address the ambiguity in individuals' specific momentary experiences, this work used theory-based cardiovascular responses

[1]University at Buffalo, The State University of New York, USA
[2]University of Essex, Colchester, UK

Corresponding Author:
Thomas L. Saltsman, Department of Psychology, University at Buffalo, The State University of New York, Park Hall, Buffalo, NY 14260, USA.
Email: tlsaltsm@buffalo.edu

capable of not only capturing the extent to which individuals care about an active stressor in the moment but also whether they have a more positive or negative psychological experience during the stressor.

Dispositional Mindfulness and Stress

This work draws primarily from Baer and colleagues' (2006, 2009) conceptualization, which interprets mindfulness as one overarching construct consisting of five distinct, but related facets. *Observing* refers to the tendency to notice or attend to both internal and external experiences; *Describing* refers to the tendency to label one's experiences with words; *Acting with awareness* entails the tendency to actively engage with one's activities in the moment; *Nonjudging of inner experiences* describes the tendency to evaluate one's thoughts and feelings noncritically; *Nonreactivity to inner experiences* refers to the tendency to allow thoughts to come and go without being carried away by them (Baer et al., 2006, 2009).

The overarching construct of dispositional mindfulness has been associated with various stress and coping benefits (e.g., Keng et al., 2011; Tomlinson et al., 2018), but previous work suggests that some facets may be particularly important. For instance, using a mindfulness inventory comprised largely of items relevant to the acting with awareness facet (Mindfulness Attention Awareness Scale, MAAS; Brown & Ryan, 2003), Brown et al. (2012) found that after stressor exposure, dispositional mindfulness predicted attenuated reactivity in cortisol, a stress hormone linked to uncontrollability and social threat (Dickerson & Kemeny, 2004). Furthermore, veterans higher in nonjudging of inner experiences (but not other mindfulness facets) reported lower post-traumatic stress disorder symptoms (Wahbeh et al., 2011), whereas the nonjudging and acting with awareness facets (along with nonreactivity to inner experiences) have been found to be particularly important in predicting depression, anxiety, stress, and well-being (Soysa & Wilcomb, 2015).

Nonetheless, there are points of ambiguity in this literature. In particular, past work examining momentary responses to stressors has relied on physiological markers that can lack specificity in their psychological interpretation (Seery & Quinton, 2016). For instance, work using cortisol reactivity to assess mindfulness' effects has drawn similarly positive conclusions from effects in opposite directions. Brown et al. (2012) argued that *low* cortisol reactivity indicates an attenuated stress response, whereas Creswell et al. (2014) argued that *high* cortisol reactivity may indicate greater engagement and active coping; both directions were interpreted as potentially positive stress outcomes related to mindfulness. Furthermore, cortisol responses are delayed relative to stressor onset, typically peaking approximately 20 min later (Dickerson & Kemeny, 2004). The current research thus relied on momentary stress responses capable of capturing the nature and valence of individuals' experiences during active stressors more precisely. Specifically, we used noninvasive cardiovascular responses from the perspective of the biopsychosocial model of challenge/threat (BPSC/T; Blascovich, 2008; Blascovich & Tomaka, 1996; Seery, 2011, 2013; Seery & Quinton, 2016).

BPSC/T

In the context of active stressors, the BPSC/T holds that individuals' level of *task engagement* represents the degree to which the goal is perceived to be important or self-relevant (i.e., how much individuals "care"), with greater task engagement corresponding to perceiving a goal as more subjectively valuable. Assuming task engagement, evaluations of personal resources and situational demands determine the extent to which individuals experience psychological states of challenge versus threat. *Challenge* occurs when individuals evaluate high personal resources and low situational demands. Conversely, *threat* occurs when individuals evaluate low resources and high demands. Despite these discrete labels, challenge and threat represent two anchors of a single bipolar continuum, such that relative differences in challenge/threat (i.e., greater vs. lesser challenge) are meaningful and reflect the basis for hypotheses (for additional discussion, see Seery & Quinton, 2016).

Four cardiovascular measures are used to index task engagement and challenge/threat during motivated performance situations: heart rate (HR); ventricular contractility (VC), a measure of the left ventricle's contractile force (preejection period reactivity $\times -1$); cardiac output (CO), the amount of blood pumped by the heart; and total peripheral resistance (TPR), a measure of net constriction versus dilation in the arterial system. Task engagement is thought to result in an increase in sympathetic-adrenomedullary axis activation and thus increases in HR and VC from baseline, both of which are common across the challenge/threat continuum (Seery, 2011, 2013). Larger increases in HR and VC reflect greater engagement (e.g., Seery et al., 2009). Given task engagement, challenge is thought to lead to greater release of epinephrine than threat, which results in relative dilation in arteries supplying skeletal muscles with blood (e.g., in arms and legs), thereby facilitating the heart in pumping more blood (Seery, 2011, 2013) Thus, challenge is marked by lower TPR and higher CO than threat, such that relatively lower TPR and higher CO reflect greater challenge or lesser threat. These cardiovascular responses do not equate to challenge/threat itself, but instead represent a measure of the underlying psychological state. The validity of these cardiovascular markers has been supported by dozens of studies (for reviews, see Blascovich, 2008; Seery, 2013; Seery & Quinton, 2016). These cardiovascular measures have been found to reliably detect small to moderate effect sizes across a vast range of contexts and individual differences, including self-esteem and social anxiety (e.g., Seery et al., 2004; Shimizu et al., 2011).

Hypotheses

We collected six psychophysiological samples to examine the role of dispositional mindfulness (and its separate facets) in predicting cardiovascular responses of task engagement and challenge/threat during active performance stressors.[1] Given previous research, we held competing hypotheses for the effect of dispositional mindfulness on the degree to which individuals experience the stressor at hand as important (i.e., task engagement). Specifically, past work suggests that higher dispositional mindfulness should generally predict attenuated stress responses (Brown et al., 2012; Bullis et al., 2014; Hertz et al., 2015; Laurent et al., 2013). This would suggest lower task engagement (manifested as lower HR and VC), consistent with "not sweating the small stuff" represented by an active stressor in a laboratory. The nonjudging of inner experiences facet, in particular, could reflect evaluating active stressors as less important because there is less at stake without self-judgment. However, if one is fully immersed in the present moment and undistracted by other concerns (fitting the acting with awareness facet), this may predict placing greater care and focus on the present goal, suggesting greater task engagement. Following this logic, to the extent that dispositional mindfulness predicts higher task engagement (higher HR and VC), the acting with awareness facet should be particularly important in this relationship. In sum, we held competing hypotheses for the relationships between dispositional mindfulness and task engagement: (a) greater mindfulness could predict lower task engagement during active stressors, consistent with evaluating it as less important (i.e., "caring" less), potentially strongest for the nonjudging facet in particular; (b) the acting with awareness facet in particular could predict higher task engagement, consistent with perceiving the task as more important due to being more immersed in the present moment.

In contrast to competing hypotheses for task engagement, the literature suggests a relatively clear direction for the relationship between dispositional mindfulness and challenge/threat responses. Previous work argues that dispositional mindfulness generally predicts greater self-efficacy (e.g., Hanley et al., 2015; Wright & Schutte, 2013) and test performance (e.g., Bellinger et al., 2015; Kee & Liu, 2011), both of which have been associated with greater relative challenge (Hase et al., 2019; Jones et al., 2009). Thus, we hypothesized that overall mindfulness should predict momentary cardiovascular responses consistent with greater relative challenge. Psychologically, greater relative challenge in this context represents evaluating relatively high resources to meet situational demands, or feeling capable of taking on a given performance stressor. We further hypothesized that the nonjudging of inner experiences facet, which refers to individuals' tendency to evaluate thoughts and experiences through a nonvalenced and noncritical lens, would be most central for this relationship, given its conceptual relevance for evaluating situations positively.

Method

Participants

Across six samples, 1,001 introductory psychology students (469 women) participated in return for partial course credit (130 participants in Sample 1; 96 in Sample 2; 226 in Sample 3; 173 in Sample 4; 194 in Sample 5; and 182 in Sample 6). In a typical study with our set of cardiovascular measures, approximately 10%–15% of the sample may be lost due to recording problems. Across all six samples, a total of 117 additional participants were excluded from analyses for the following reasons: 48 due to missing or unusable blood pressure data during the task of interest, 16 due to missing all psychophysiological data, 27 due to unusable impedance cardiography data, seven due to unusable electrocardiography data (two of these due to an irregular heartbeat that impacted data processing), 16 due to missing data for the dispositional mindfulness questionnaire, and three for computer malfunction. Notably, although we only made data exclusions based on technical and cardiovascular recording issues, inclusion criteria did vary somewhat across studies. Specifically, Samples 1 to 3, 5, and 6 were only accessible to those who reported being at least moderately fluent in both reading and/or writing English during a mass-testing session. Furthermore, because of the original hypotheses for Sample 4, only female participants whose native language was listed as English were included in this sample. Collectively, 1,001 participants provide adequate power ($>.80$) to detect an effect size of approximately $\eta_p^2 = .008$. In three of the six samples (2, 3, 6), we also collected self-reported, retrospective evaluations of the performance stressor. Five participants exited the study session prior to completing self-reported evaluations, leaving 499 total participants with this data and providing adequate power to detect an effect size of approximately $\eta_p^2 = .016$.

The size of each sample was determined as follows. Given that this was the first study to our knowledge examining dispositional mindfulness and challenge/threat responses, we conducted a power analysis for Sample 1 anticipating a moderate effect size would emerge for this relationship between dispositional mindfulness and challenge/threat responses ($\eta_p^2 = .05$). To provide adequate power ($>.80$) for this effect size, we estimated that roughly 150 participants would be needed. Although we collected data from over 150 participants, only 130 participants had usable data in Sample 1. Given that acting with awareness demonstrated the most theoretically and empirically compelling relationship with challenge/threat responses in Sample 1, Samples 2 and 3 were powered based on the effect size of the acting with awareness facet on challenge/threat responses from this initial sample ($\eta_p^2 = .029$), which suggested a sample size of approximately 210 participants (one-tailed). Although we exceeded this sample size for Sample 3 ($N = 226$), Sample 2 was limited by laboratory resources and participant pool access. Samples 4 to 6 were all designed to test other theoretical questions and were powered based on effect sizes from their respective literatures.

Study Overview

In all samples, participants completed an assessment of mindfulness (i.e., the Five Facet Mindfulness Questionnaire–Short Form [FFMQ-SF]; Baer et al., 2006; Bohlmeijer et al., 2011) either before or after engaging in an active performance stressor task, including speeches on various topics and tests of reasoning ability (i.e., the Remote Associate's Test [RAT]; McFarlin & Blascovich, 1984). Given core methodological similarities across samples, we combined them into a single data set for analyses and thus depart from the historical norm of presenting each individually (see stimulus materials document in Supplemental Material for additional sample-specific procedural details).[2]

Materials

FFMQ-SF. Baer et al. (2006) created the Five Facet Mindfulness Questionnaire (FFMQ) by compiling 39 items from various established mindfulness questionnaires (e.g., Mindful Attention Awareness Scale, Brown & Ryan, 2003; Freiburg Mindfulness Inventory, Walach et al., 2006; Kentucky Inventory of Mindfulness Inventory, Baer et al., 2004). In this work, we relied upon Bohlmeijer and colleagues' (2011) 24-item version (FFMQ-SF) to assess mindfulness as a unitary construct (α = .804), as well as assess each individual facet, including observing (α = .721), describing (α = .823), acting with awareness (α = .797), nonjudging of inner experiences (α = .766), and nonreactivity (α = .681). Although the internal consistency for the nonreactivity facet in particular was relatively low, this result is consistent with past work demonstrating that this facet tends to be the least internally consistent overall (Bohlmeijer et al., 2011). In Bohlmeijer and colleagues (2011) investigation, the nonreactivity facet yielded an alpha of .73, whereas all other facets yielded alphas surpassing .78. Sample items for each facet include "I pay attention to physical experiences, such as the wind in my hair or sun in my face" (Observing); "I'm good at finding words to describe my feelings" (Describing); "I find it difficult to stay focused on what's happening in the present moment. (reverse scored)" (Acting with awareness); "I tell myself I shouldn't be thinking the way I'm thinking. (reverse scored)" (Nonjudging); "When I have distressing thoughts or images, I don't let myself be carried away by them" (Nonreactivity).

The FFMQ-SF has been used to reliably assess mindfulness and its facets across a wide range of populations (Brady et al., 2018; Elvery et al., 2017), showing similar associations as other versions across various psychological and physiological outcomes (e.g., Brady et al., 2018; Elvery et al., 2017), including reduced negative affect (Brady et al., 2018), cortisol reactivity (Manigault et al., 2018), organizational/operational stress (Bergman et al., 2016), chronic pain intensity and catastrophizing (Elvery et al., 2017), and rejection sensitivity (Hafner et al., 2018). Participants responded using a 1 to 5 Likert-type scale (see stimulus materials document in Supplemental Material for all FFMQ-SF items).

Cardiovascular measures. Cardiovascular measures were recorded noninvasively, using accepted guidelines (Sherwood et al., 1990) and following techniques from previously published challenge/threat research (e.g., Seery et al., 2016; also see Lupien et al., 2012; Shimizu et al., 2011), including ensemble averaging in 60-s intervals (Kelsey & Guethlein, 1990). This approach is comparable with techniques used in other challenge/threat work with different equipment configurations (e.g., de Wit et al., 2012; Jamieson et al., 2012; Kassam et al., 2009; Turner et al., 2013; Vine et al., 2013).

We used the following equipment manufactured and/or distributed by Biopac Systems, Inc. (Goleta, CA): NICO100C impedance cardiography (ICG) noninvasive cardiac output module, ECG100C electrocardiogram (ECG) amplifier, and NIBP100A/B noninvasive blood pressure module. ICG signals were detected with a tetrapolar aluminum/mylar tape electrode system, recording basal transthoracic impedance (Z0) and the first derivative of impedance change (dZ/dt), sampled at 1 kHz. Using a Standard Lead II electrode configuration (additional spot electrodes on the right arm and left leg, with ground provided by the ICG system), ECG signals were detected and sampled at 1 kHz. The blood pressure monitor was wrist-mounted, collecting continual readings (every 10–15 s) from the radial artery of participants' nondominant arm. Together, ICG and ECG recordings allowed computation of HR, VC (i.e., pre-ejection period reactivity $\times$ –1), and CO. Blood pressure data was used to compute TPR (mean arterial pressure $\times$ 80/CO; Sherwood et al., 1990). Recorded measurements of cardiovascular function were stored on a computer and analyzed off-line with Biopac Acqknowledge 3.9.2 for Macintosh software. Scoring of cardiovascular data was performed blind to other participant data.

Retrospective self-report measures. In three of the six samples (Samples 2, 3, and 6), we also collected self-reported retrospective evaluations of the active stressor. After completing the performance task of interest, 499 participants responded to five items (αs = .75–.77) assessing the degree to which they evaluated the task and their performance positively. Specifically, items included "I did well on this task," "I am not skilled at this task (reverse scored)," "I did not enjoy this task (reverse scored)," "I would enjoy doing this task again," and "This task was difficult (reverse scored)." Responses were assessed on a scale from 1 = *Completely disagree* to 7 = *Completely agree*, and a composite measure of overall positivity in retrospective self-report evaluations was created for each sample.[3]

Procedures

In Samples 1 to 3 and 6, participants completed the FFMQ-SF upon entering the lab. In Sample 4, participants completed the FFMQ-SF in a preliminary mass-testing session before their laboratory session, whereas participants in Sample 5 completed the FFMQ-SF after the task of interest. In all six samples, participants sat for a 5-min resting baseline period prior to completing either one or multiple active performance stressors, including various speeches and tests of reasoning ability (i.e., the RAT; McFarlin & Blascovich, 1984). For each speech task, participants were provided 2 min to give a speech on a specific topic (e.g., a current obstacle or set-back). Participants were encouraged to use the full 2 min for the speech. For the tests of reasoning ability, participants completed either a medium or high-difficulty version of the RAT. In all versions, we presented the RAT to participants under the guise that it measured intelligence and predicted important life outcomes. Each of the 12 items included on the RAT required participants to generate a single word that linked three stimulus words together. Participants had 15 s to generate an answer before the presenting computer advanced to the next item (3 min total).

Attesting to these tasks reflecting stressors (for additional discussion, see Seery & Quinton, 2016), the current work's motivated performance situations were highly similar to tasks used in the Trier Social Stress Test (TSST; Kirschbaum et al., 1993). The TSST has been used in over 4,000 studies examining a wide range of outcome variables relevant to stress, such as subjective verbal reports, objective behavioral responses, and biological responses including parameters of the hypothalamic-pituitary-adrenal (HPA) axis and SAM (sympathoadrenal medullary) axis and cardiovascular and immunological systems (see Kudielka et al., 2007, for a review). Similar to the TSST, participants in the current work engaged in free speaking activities, as well as evaluative performance tests. Diverging from the TSST, participants completed motivated performance tasks in individual testing rooms. Importantly, although the experimenter was not physically present during task performance, participants were aware that an experimenter was observing and evaluating their performance from another room, which has been shown to induce similar psychological and physiological reactivity as performing in front of an audience. For instance, even when completed in isolation, past work demonstrates that such evaluative tasks not only increase levels of sympathetic nervous system activity (including HR, VC, and blood pressure; Blascovich et al., 2004; de Wit et al., 2012; Le et al., 2019; Lynch et al., 1980; Seery et al., 2009) but also state anxiety (Hofmann et al., 2009), as well as other stress-related emotions such as fear and embarrassment (Hofmann et al., 2006). As in the TSST, it is possible that the motor activity entailed in these tasks (e.g., the act of speaking) contributes to cardiovascular reactivity independently of stressor-related psychological influences during them. However, evidence shows that psychological influences—such as stemming from the presence of others (Blascovich et al., 1999) and monetary incentive (Seery et al., 2009)—lead to differences in reactivity during otherwise identical tasks.

Results

Analytical Strategy

Integrated data analysis. All samples utilized the same measure of mindfulness and the same cardiovascular measures during active stressors. Following recommendations to examine replicability across multiple samples, we present our studies collectively using integrated data analysis (Curran & Hussong, 2009; Dunlop et al., 2020), appropriate for bringing together multiple studies with access to original raw data. We aggregated the six samples into a single data file, and standardized all variables within each study. Controlling for dummy-coded sample (no interactions with sample approached significance), we regressed cardiovascular responses of task engagement and challenge/threat onto self-reported dispositional mindfulness (and, separately, each of its individual facets). As described in Steiger (2004), given that η_p^2 cannot be negative, 90% confidence intervals (CIs) rather than 95% CIs reflect alpha = .05 and correspond to p values (95% CIs can misleadingly include zero even when $p < .05$). To further substantiate our findings, we also used a meta-analysis across the samples, treating them as separate (Braver et al., 2014; Chan & Arvey, 2012; Fabrigar & Wegener, 2016; Goh et al., 2016).

Cardiovascular responses. As is standard in challenge/threat research (e.g., Lupien et al., 2012; Scheepers et al., 2012; Seery et al., 2013), cardiovascular reactivity values were calculated by subtracting responses observed during the last resting baseline minute from those observed during each minute of each active performance stressor (the mean of these reactivity values was used in analyses; see Llabre et al., 1991 for psychometric justification for the use of change scores in psychophysiology). To include as much cardiovascular data as possible, for samples in which cardiovascular responses were assessed across two separate tasks, reactivity was averaged across both task periods. For extreme reactivity values greater than 3.3*SD*s from the mean (p = .001 in a normal distribution; Tabachnick & Fidell, 1996), we winsorized values by adjusting each to be 1% above the next-highest nonextreme value.[4] This maintained the rank order in the distribution while decreasing the influence of extreme values.

Theoretically, changes in (a) HR and VC and (b) TPR and CO should reflect the same underlying physiological activation and indicate relative differences in (a) task engagement and (b) challenge/threat, respectively. As is standard practice (e.g., Blascovich et al., 2004; de Wit et al., 2012; Seery et al., 2009), cardiovascular measures were combined into task engagement (HR and VC) and challenge/threat (TPR and CO) indices to (a) maximize the reliability of the cardiovascular measures, analogous to averaging over multiple items on a self-report scale; and (b) assess the relative pattern across the two component measures for each index within participants (e.g., differentiating between individuals with high TPR and low CO vs. those with high TPR and moderate CO). In each sample, we first converted participants' HR and VC reactivity values into *z*-scores and then summed them, such that higher values represented cardiovascular reactivity consistent with greater task engagement. Similarly, we converted TPR and CO reactivity values into *z*-scores, reverse scored TPR because TPR and CO should respond in opposite directions, and summed the resultant scores, such that higher values represented cardiovascular reactivity consistent with greater challenge. Each resulting index was then standardized for ease of interpretation ($M = 0$, $SD = 1$). Importantly, differences on this index are relative, such that the zero point represents the sample mean (e.g., rather than a demarcation point between challenge vs. threat).

Task Engagement

Before testing relative differences in task engagement, it was important to first confirm that participants as a whole exhibited significant increases from baseline in HR and VC during each active performance stressor, as increases in HR and VC during task performance are prerequisites for both challenge and threat cardiovascular patterns. Consistent with past work, in all samples, one-sample *t*-tests revealed that HR and VC reactivity were significantly greater than zero during each active performance task period, all ts > 4.36, Ms > 3.18, ps $< .001$, $d = 0.44$. Furthermore, testing this association across the entire collective sample yielded the same interpretation for heart rate, $t(1{,}000) = 37.54$, $M = 8.59$, $p < .001$, $d = 1.19$, and ventricular contractility, $t(1{,}000) = 16.55$, $M = 4.78$, $p < .001$, $d = 0.52$. See Table 1 for a correlation matrix and descriptive statistics for all measures.

We held competing hypotheses for the relationships between dispositional mindfulness and cardiovascular responses consistent with task engagement (combination of HR and VC reactivity): (a) higher overall mindfulness could predict lower task engagement during active stressors, consistent with evaluating the stressor and its consequences as less important (i.e., "caring" less), perhaps driven by the nonjudging facet in particular; (b) the acting with awareness facet in particular could predict higher task engagement, consistent with evaluating the task at hand as more important due to being more immersed in the present moment.

Contrary to the first possibility, we found that overall mindfulness predicted cardiovascular responses consistent with significantly *greater* task engagement during active stressors, $b = .068$, $t(994) = 2.16$, $p = .031$, $\eta_p^2 = .005$, 90% CI = [.000, .0143]. Supporting the second possibility, the acting with awareness facet was the only facet that predicted significantly greater task engagement when examined in isolation, $b = .095$, $t(994) = 3.02$, $p = .003$, $\eta_p^2 = .009$, 90% CI = [.002, .021]. No other individual mindfulness facets significantly predicted task engagement, bs < 0.047, ts < 1.50, ps $> .135$, including nonjudging ($p = .135$).[5] These task engagement findings suggest that those who reported being high in dispositional mindfulness overall—and high on the acting with awareness facet, particularly—evaluated the active stressors as holding more importance and self-relevance than did those who were low in dispositional mindfulness.

Challenge/Threat

We hypothesized that higher overall mindfulness and higher nonjudging of inner experiences in particular would predict evaluating higher resources/lower demands and thus experiencing greater challenge and exhibiting the accompanying cardiovascular reactivity (combination of TPR and CO). However, failing to support these hypotheses, we found no evidence that overall mindfulness or any of its individual facets significantly predicted challenge/threat responses during active stressors, bs < 0.032, $t(994) < 1.02$, ps $> .309$, including nonjudging ($p = .749$).[6] In other words, despite prior suggestions of mindfulness' benefits for stress, we found no evidence that individuals higher in dispositional mindfulness (or any of its individual facets) actually exhibited more positive momentary experiences during active stressors than those low in dispositional mindfulness.

Retrospective Self-Report

We also tested the relationship between dispositional mindfulness and participants' self-reported retrospective evaluations of the task and their performance. Despite the lack of evidence for differences in cardiovascular responses consistent with challenge/threat, we found that overall mindfulness predicted significantly more positive evaluations of active stressors after the fact, $b = .245$, $t(495) = 5.19$, $p < .001$, $\eta_p^2 = .052$, 90% CI = [.024, .086]. Furthermore, with one exception (observing facet $p = .082$), higher scores on each mindfulness facet significantly predicted more positive retrospective evaluations, bs > 0.096, ts > 1.99, ps $< .047$, $\eta_p^2 > .008$, including nonjudging ($p = .047$).

To formally test the divergence between lack of positive challenge response associated with higher mindfulness *during* active stressors but more positive self-reports *after*, we tested the interaction between mindfulness and repeated-measures outcome variable (challenge/threat index vs. self-report) in a mixed model. Specifically, we first ensured that responses for the challenge/threat index and self-report scale were both standardized, and then treated these standardized scores as a within-subjects variable, with challenge/threat index representing scores at Time 1 and self-report responses representing scores at Time 2. Then, we assessed the interaction between dispositional mindfulness and the factor "Time"

Table 1. Correlations and Descriptive Statistics.

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Challenge/threat index	—												
2. TPR reactivity	−.906***	—											
3. CO reactivity	.906***	−.642***	—										
4. Task engagement index	.256***	−.083**	.379***	—									
5. HR reactivity	.049	.074*	.163***	.845***	—								
6. VC reactivity	.384***	−.215***	.480***	.845***	.429***	—							
7. Self-report (dispositional mindfulness)	−.096*	.064	−.108*	−.070	−.020	−.099*	—						
8. Overall mindfulness	−.008	.042	.027	.068*	.044	.072*	.227***	—					
9. Observing	−.014	.032	.005	.022	.027	.010	.078	.337***	—				
10. Describing	.003	.008	.014	.006	.015	−.003	.226***	.680***	.092*	—			
11. Acting with awareness	.024	.009	.053	.095**	.070*	.092**	.136**	.673***	−.003	.337***	—		
12. Nonjudging	−.010	.021	.003	.047	.013	.066*	.089*	.623***	−.135***	.270***	.397***	—	
13. Nonreactivity	−.032	.056	−.002	.018	−.004	.034	.107*	.569***	.166***	.207***	.168***	.186***	—
M	0	144.297	−0.161	0	8.593	4.782	3.685	3.268	3.551	3.335	3.295	3.079	3.135
SD	0.997	180.268	1.559	0.997	7.242	9.141	1.119	0.415	0.752	0.737	0.707	0.728	0.635

Note. TPR = total peripheral resistance, CO = cardiac output, HR = heart rate, VC = ventricular contractility. N = 1,001 for all data except self-report (N = 496).
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 2. Summary of Regression Analyses for Individual Samples.

Outcome measure	Sample	Overall mindfulness		Observing		Describing		Acting with awareness		Nonjudging		Nonreactive	
		b	η_p^2	b	η_p^2	b	η_p^2	b	η_p^2	b	η_p^2	b	η_p^2
Engagement	1	.054	.003	.024	.001	.016	.000	.054	.003	.089	.008	−.020	.000
	2	.092	.008	−.086	.007	−.020	.000	.232*	.054	.132	.017	−.023	.001
	3	.072	.005	.075	.006	−.037	.001	.067	.004	.080	.006	.016	.000
	4	.068	.005	.042	.002	−.009	.000	.075	.006	.078	.006	.010	.000
	5	.083	.007	−.043	.002	.109	.012	.081	.007	.031	.001	.040	.002
	6	.046	.002	.063	.004	−.028	.001	.124†	.015	−.077	.006	.052	.003
C/T index	1	.147†	.022	.102	.010	.069	.005	.169†	.029	.116	.013	−.012	.000
	2	−.009	.000	−.100	.010	−.072	.005	.091	.008	.059	.003	−.018	.000
	3	−.032	.001	−.091	.008	−.028	.001	.027	.001	.002	.000	−.013	.000
	4	.020	.000	−.029	.000	.062	.004	.039	.002	−.029	.000	.008	.000
	5	−.053	.003	−.034	.001	.035	.001	−.067	.004	−.043	.002	−.057	.003
	6	−.068	.005	.079	.006	−.054	.003	−.034	.001	−.097	.009	−.090	.008
Self-report	2	.432***	.186	.266**	.071	.400***	.161	.186†	.035	.209*	.044	.145	.021
	3	.115	.012	.035	.001	.078	.005	.088	.007	.059	.003	.064	.004
	6	.309***	.072	.049	.002	.367***	.102	.197*	.030	.082	.005	.163†	.020

Note. Engagement = task engagement cardiovascular index. C/T index = challenge/threat cardiovascular index. Self-report = post-stressor self-reports.
†$p < .1$. *$p < .05$. **$p < .01$. ***$p < .001$.

on these standardized scores. This analysis revealed a significant interaction, $b = .286$, $z = 4.40$, $p < .001$, demonstrating that overall mindfulness predicted post-stressor self-reports in a significantly different pattern than mid-stressor cardiovascular challenge/threat responses.

Meta-Analysis

For each of the outcome variables, we calculated Fisher's *Zr* for the effect observed in each sample (the effect of dispositional mindfulness on each outcome variable) and then tested the mean weighted value of *Zr* across samples. Although we report our results as a collective, Table 2 contains results for each individual sample. The meta-analysis results paralleled findings from the integrated data analysis. Overall mindfulness significantly predicted cardiovascular responses consistent with greater task engagement during performance, $r = .068$, $z = 2.14$, $p = .032$, 95% CI = [.006, .130]. Acting with awareness was the only facet that significantly predicted task engagement when examined in isolation, $r = .096$, $z = 3.01$, $p = .003$, 95% CI = [.033, .157]. No other individual mindfulness facets significantly predicted task engagement responses, *r*s < .048, *z*s < 1.49, *p*s > .135. As in the integrated data analysis approach, we found no evidence that overall mindfulness or any of its individual facets significantly predicted challenge/threat responses across studies, *r*s < .03, *z*s < 1.02, *p*s > .309. However, again we found support that overall mindfulness (and its individual facets) predicted more positive evaluations of active stressors after the fact, $r = .237$, $z = 5.24$, $p < .001$, 95% CI = [.147, .314]. Relatively high scores on each mindfulness facet—except for the observing facet, $r = .082$, $z = 1.82$, $p < .068$, 95% CI = [0, .169]—significantly predicted more positive evaluations.

Addressing Potential Confounding Variables

Considering the positively valanced nature of items on the FFMQ-SF and the correlational nature of our examination, our findings could reflect a tendency for individuals high in mindfulness to simply report positive responses broadly. To examine this possibility, we assessed a similarly positively valanced construct in all samples: trait self-esteem (Rosenberg, 1965). Importantly, all significant effects reported above (with one exception) emerged when self-esteem was included as a covariate in analyses, the sole exception being overall mindfulness on task engagement responses, $b = .063$, $t(971) = 1.93$, $p = .053$. This suggests that the observed relationships largely exist above and beyond a similarly positively valanced construct, providing evidence that these responses are specific to mindfulness rather than a positivity bias in self-reporting. Furthermore, we also assessed a range of demographic measures across samples, including age, gender, race/ethnicity, native language, and country of origin (see Stimulus Materials in Supplemental Material, Table 1 for additional descriptive information). Importantly, all significant effects (with one exception) remained so when controlling for these variables individually, as well as when all variables were included in the same statistical model. The sole exception was the effect of nonreactivity on post-task self-report evaluations, which only approached significance when controlling for all demographic variables simultaneously, $b = .095$, $t(485) = 1.87$, $p = .063$.

Discussion

Using an integrated data analysis approach, the current work combined six samples to examine the role of dispositional mindfulness and its facets in predicting cardiovascular responses of task engagement and challenge/threat during active performance stressors. Given previous research, we held competing hypotheses for the effect of dispositional mindfulness on cardiovascular responses of task engagement. Specifically, past work argued that higher mindfulness should generally predict less reactivity to stress (Brown et al., 2012; Bullis et al., 2014; Hertz et al., 2015; Laurent et al., 2013), potentially consistent with evaluating an active stressor as less important in the grand scheme of things and thereby leading to lower task engagement. If a lack of self-judgment creates a sense of less being at stake, it was plausible that the nonjudging of inner experiences facet could drive this relationship. However, being more fully immersed in the present moment (reflective of the acting with awareness facet) could predict evaluating higher importance for the task at hand, leading to higher task engagement. Results were contrary to the first possibility but consistent with the second: Higher overall mindfulness predicted cardiovascular responses consistent with *greater* task engagement during active stressors, as did higher acting with awareness. The overall mindfulness effect thus appeared to be largely driven by the acting with awareness facet, as it was the only facet that reached significance in isolation. This suggests that by focusing on the present moment, individuals who are higher in acting with awareness may care more deeply about an active stressor while it occurs, evaluating it as more important. This effect was relatively small. Nonetheless, at least in the context of active stressors as they happen, it is inconsistent with dispositional mindfulness being associated with stress responses of generally lower magnitude.

Although competing hypotheses seemed plausible for task engagement, the direction of the relationship between dispositional mindfulness and challenge/threat cardiovascular responses seemed clear: Higher dispositional mindfulness should predict greater challenge. Past work shows relationships between mindfulness and greater self-efficacy (e.g., Hanley et al., 2015; Wright & Schutte, 2013) and test performance (e.g., Bellinger et al., 2015; Kee & Liu, 2011), which are potentially consistent with greater challenge (e.g., Blascovich, 2008; Hase et al., 2019; Seery, 2011, 2013). We further hypothesized that the nonjudging of inner experiences facet should be most relevant for challenge/threat, given its conceptual link to evaluating situations positively. Failing to support our hypotheses, neither overall mindfulness nor the nonjudging facet significantly predicted challenge/threat responses, despite a sample large enough to provide ample power to detect even a small relationship.

This pattern of cardiovascular responses suggests that individuals high in dispositional mindfulness evaluated active stressors as being more important and self-relevant than did people low in mindfulness, but did not differ in the valence of their experience during stressors. Interestingly, despite mindfulness failing to predict cardiovascular responses consistent with greater challenge, overall mindfulness did predict significantly more positive self-reported retrospective evaluations of the stressor and performance of it. In other words, participants higher in mindfulness reported having a more positive experience *after* the stressor, without showing evidence of more positively valenced evaluations in the form of challenge *during* the stressor. This divergence was further supported by a repeated-measures analysis. Importantly, this difference in post-stressor evaluations does not seem to be purely an artifact of a positivity bias, as these effects remained significant when controlling for a similarly positively valanced construct: self-esteem. The current results also emerged when controlling for other potentially relevant demographic variables, including age, gender, race/ethnicity, native language, and country of origin.

Related to our findings, other work has focused on the degree to which the emotion regulatory benefits of dispositional mindfulness emerge immediately and in the moment of stressor exposure, or remain more reflective in nature, emerging as one interprets an experience after the fact (van den Hurk et al., 2010; Westbrook et al., 2011). The current findings build upon this work, suggesting that mindfulness assessed on a trait level may be more central in regulating responses to stressors after the fact. Specifically, it may be the case that being higher in mindfulness, though only modestly affecting momentary responses, facilitates more positive interpretations of one's experiences post-stressor. Retrospective positive interpretations may be important in their own right, but to the extent they diverge from the reality of one's actual experience at the time, it could lead mindfulness to be associated with the perception of well-being rather than actual well-being.

Limitations and Future Directions

Across samples, we found that participants' responses to the FFMQ-SF were around the midpoint of the scale ($M = 3.27$), which could suggest that our samples consisted of relatively mindful individuals. However, our work did not fully consider a potentially important moderator in these responses: individuals' experiences with meditation practice. Chiesa et al. (2013) argued that mindfulness's impact on stress and coping may differ as a function of practice history. For short-term practitioners (i.e., meditation naïve individuals), mindfulness may be more likely to be associated with benefits to reflective coping, whereas for long-term practitioners (i.e., experienced meditators), mindfulness may be more likely to be associated with benefits to experiences in the moment. In this work, there are multiple reasons to expect that our samples were predominantly meditation naïve participants. One, the observing facet was not significantly correlated with the acting with awareness facet and was negatively correlated with the nonjudging facet, despite both being components of the same overarching mindfulness construct. Previous works have reported similar relationships between the observing facet and other mindfulness facets (Baer et al., 2006; Bohlmeijer et al., 2011; Christopher et al., 2012; de Bruin et al., 2012), but have noted that such relationships tend to occur among meditation naïve participants. In addition, in two of the six samples in this work, we assessed individuals' level of mindfulness meditation training. These participants reported relatively little experience with meditation, with the average response falling between "I have never meditated" and "I've meditated once or occasionally, never regularly or semi-regularly." Although data for meditation history are only available for two samples, all samples recruited participants from the same participant pool; levels of meditation training were thus likely somewhat similar across samples.

Taken together, it remains possible that the relatively weak evidence for differences in momentary cardiovascular responses is in part due to our samples' likely unfamiliarity with meditation. Importantly, our results do not speak to effects of meditation training. It is possible that effects of training do not depend on dispositional mindfulness, or that training and dispositional mindfulness interact. Related to this limitation, our samples consisted entirely of undergraduate students, over 94% of whom were between the ages of 18 and 21 years. Given work demonstrating that levels of dispositional mindfulness increase across the lifespan (e.g., Hohaus & Spark, 2013), it is also possible that our results would differ within an older and more diverse sample. Future work could use cardiovascular responses from the perspective of the BPSC/T to examine meditation training and experience, as well as focus on other populations. Doing so could reveal more about when mindfulness is related to responses during versus after stressors.

This work relied exclusively on one assessment of mindfulness: The FFMQ-SF (Bohlmeijer et al., 2011). Although this measure is commonly used across multiple populations, some researchers argue that dispositional mindfulness as a construct should be more narrowly constrained to an attention or awareness component (Brown & Ryan, 2003), whereas others argue that additional components (e.g., orientations toward curiosity and openness) are also central (Bishop et al., 2004). Considering that the acting with awareness facet predicted task engagement cardiovascular responses but other facets did not, it may be the case that conceptualizations more deeply rooted in attention and awareness (e.g., Brown & Ryan, 2003; MAAS) are simply more relevant for predicting momentary responses during active stressors. Future work could examine alternative operationalizations and conceptualizations of mindfulness to test responses in this context.

Conclusion

Despite research touting mindfulness' various benefits for stress and coping, this work found little to no evidence of such an association for responses *during* active stressors. Across six psychophysiological samples (N = 1,001), we used theory-based psychophysiological measures to examine the role of dispositional mindfulness and its separate facets in predicting cardiovascular responses of task engagement and challenge/threat during active stressors. Notably, in this work, we conceptualized active stressors as motivated performance tasks in which individuals must carry out instrumental behaviors to reach valued goals (e.g., taking an evaluative test, giving a speech). Although we found a small but reliable association between overall mindfulness—and particularly the acting with awareness facet—and cardiovascular responses consistent with perceiving stressors as more important or self-relevant (i.e., greater task engagement), we found no evidence that mindfulness was associated with exhibiting a more positive psychological response *during* stressors (i.e., greater challenge). Despite no differences in the valence of their experiences in the moment, individuals higher in mindfulness did report more positive experiences after active stressors.

It could be tempting to conclude that our findings undermine previous work supporting dispositional mindfulness's assumed stress and coping benefits. However, such a strong conclusion seems ill advised, given the substantial body of research that supports the association of dispositional mindfulness with positive responses. Instead, it seems reasonable to view the current work as capturing a novel boundary condition: Dispositional mindfulness was associated with benefits *after* an active stressor but not *during* one. These results further stress the importance of utilizing a wide range of multi-faceted measurement tools to study the effects of mindfulness (e.g., self-report, implicit, behavioral, and psychophysiological measures). For instance, if the current work solely relied on momentary cardiovascular responses, we might conclude that mindfulness is effectively useless in predicting individuals' experiences in response to active stressors. At the same time, if this work solely relied on post-task self-reported evaluations of one's experience, we would applaud the seemingly obvious psychological benefits of dispositional mindfulness in this context. We do not intend to suggest that any single measurement tool necessarily holds more meaning or merit in this context, but rather that utilizing a combination of these measures may ultimately be central to understanding mindfulness as a theoretical construct. In this work, our multi-method approach allowed us to develop a novel and nuanced depiction of dispositional mindfulness, highlighting ways in which it may be beneficial, as well as ways in which it may not.

In sum, although we emphasize the importance of interpreting our findings in the context of active stressors, this work does provide compelling evidence that dispositional mindfulness can matter more for interpreting stressor-related experience after the fact rather than during exposure. This is not to say that such effects are not or cannot be important. However, it does raise the possibility that dispositional mindfulness may be limited in the depth and scope of its associated benefits, at least in this context. In other words, dispositional mindfulness may help in not sweating the small stuff, but only after it is already over, not while it is still happening.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Preparation of this manuscript was supported by the National Science Foundation Grant BCS-1823497 to M.D.S.

ORCID iDs

Thomas L. Saltsman https://orcid.org/0000-0002-0239-5291
Deborah E. Ward https://orcid.org/0000-0002-2574-4861
Veronica M. Lamarche https://orcid.org/0000-0002-2199-6463

Supplemental Material

Supplemental material is available online with this article.

Notes

1. Sample 6 is the only sample containing previously published data. Le et al. (2019) examined a distinct theoretical question and did not incorporate mindfulness in analyses. Although the same cardiovascular variables are used here, no analyses overlap.
2. The relationship between dispositional mindfulness and cardiovascular responses remained the same regardless of task type (i.e., speech vs. RAT). Thus, we do not report separate analyses for each task type.
3. Participants also reported the extent to which they tried hard and tried their best during the task. Because the valence of these items is unclear, they were not included in analyses.
4. The number of winsorized values across samples were as follows. Sample 1: one value for HR, three values for VC, three values for CO, three values for TPR; Sample 2: zero values for HR, three values for VC, one value for CO, five values for TPR; Sample 3: four values for HR, five values for VC, two values for CO, four values for TPR; Sample 4: two values for HR, two values for VC, two values for CO, three values for TPR; Sample 5: two values for HR, three values for VC, three values for CO, three values for TPR; Sample 6: one for HR, one for VC, one for CO, and four for TPR.
5. Although our hypotheses were based on testing differences in the task engagement index, we also examined results for HR and VC separately. Specifically, overall mindfulness did not predict increases in HR, $b = .044$, $t(994) = 1.38$, $p = .168$, $\eta_p^2 = .002$, 90% CI = [0, .008], but did significantly predict increases in VC, $b = .716$, $t(994) = 2.26$, $p = .024$, $\eta_p^2 = .005$, 90% CI = [.0004, .015]. Furthermore, the acting with awareness facet predicted significant increases in both HR, $b = .070$, $t(994) = 2.20$, $p = .028$, $\eta_p^2 = .005$, 90% CI = [.0002, .014], and VC, $b = .092$, $t(994) = 2.91$, $p = .004$, $\eta_p^2 = .008$, 90% CI = [.001, .019]. Differences in HR and VC did not approach significance for any of the other facets, except for a significant effect for nonjudging predicting greater VC, $b = .066$, $t(994) = 2.07$, $p = .038$, $\eta_p^2 = .004$, 90% CI = [0, .013].
6. Although our hypotheses were based on observing differences in the challenge/threat index, we also separately examined differences in responses for CO and TPR. We found no significant differences for mindfulness or any of its facets when examining CO and TPR responses in isolation; however, a marginally significant effect between nonreactivity and TPR emerged, bs < .056, ts < 1.77, ps > .077, $\eta_p^2 = <.003$.

References

Baer, R. A., Smith, G. T., & Allen, K. B. (2004). Assessment of mindfulness by self-report: The Kentucky Inventory of Mindfulness skills. *Assessment*, *11*, 191–206. https://doi.org/10.1177/1073191104268029

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, *13*, 27–45. https://doi.org/10.1177/1073191105283504

Baer, R. A., Walsh, E., & Lykins, E. L. B. (2009). Assessment of mindfulness. In F. Didonna (Ed.), *Clinical handbook of mindfulness* (pp. 153–168). Springer.

Bellinger, D. B., DeCaro, M. S., & Ralston, P. A. S. (2015). Mindfulness, anxiety, and high-stakes mathematics performance in the laboratory and classroom. *Consciousness and Cognition: An International Journal*, *37*, 123–132. https://doi.org/10.1016/j.concog.2015.09.001

Bergman, A. L., Christopher, M. S., & Bowen, S. (2016). Changes in facets of mindfulness predict stress and anger outcomes for police officers. *Mindfulness*, *7*, 851–858. https://doi.org/10.1007/s12671-016-0522-z

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . .Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*, 230–241. https://doi.org/10.1093/clipsy.bph077

Blascovich, J. (2008). Challenge and threat. In A. J. Elliot (Ed.), *Handbook of approach and avoidance motivation* (pp. 481–445). Guilford Press.

Blascovich, J., Mendes, W. B., Hunter, S. B., & Salomon, K. (1999). Social "facilitation" as challenge and threat. *Journal of Personality and Social Psychology*, *77*, 68–77. https://doi.org/10.1037/0022-3514.77.1.68

Blascovich, J., Seery, M. D., Mugridge, C. A., Norris, R. K., & Weisbuch, M. (2004). Predicting athletic performance from cardiovascular indexes of challenge and threat. *Journal of Experimental Social Psychology*, *40*, 683–688. https://doi.org/10.1016/j.jesp.2003.10.007

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 28, pp. 1–51). Academic Press.

Bohlmeijer, E., ten Klooster, P. M., Fledderus, M., Veehof, M., & Baer, R. (2011). Psychometric properties of the five facet mindfulness questionnaire in depressed adults and development of a short form. *Assessment*, *18*, 308–320. https://doi.org/10.1177/1073191111408231

Brady, B., Kneebone, I. I., & Bailey, P. E. (2018). Validation of the five facet mindfulness questionnaire among community-dwelling older adults. *Mindfulness*, *10*, 529–536. https://doi.org/10.1007/s12671-018-0994-0

Braver, S. L., Thoemmes, F. J., & Rosenthal, R. (2014). Continuously cumulating meta-analysis and replicability. *Perspectives on Psychological Science*, *9*, 333–342. https://doi.org/10.1177/1745691614529796

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*, 822–848. https://doi.org/10.1037/0022-3514.84.4.822

Brown, K. W., Weinstein, N., & Creswell, J. D. (2012). Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. *Psychoneuroendocrinology*, *37*, 2037–2041. https://doi.org/10.1016/j.psyneuen.2012.04.003

Bullis, J. R., Bøe, H. J., Asnaani, A., & Hofmann, S. G. (2014). The benefits of being mindful: Trait mindfulness predicts less stress reactivity to suppression. *Journal of Behavior Therapy and Experimental Psychiatry*, *45*, 57–66. https://doi.org/10.1016/j.jbtep.2013.07.006

Chan, M. E., & Arvey, R. D. (2012). Meta-analysis and the development of knowledge. *Perspectives on Psychological Science*, *7*, 79–92. https://doi.org/10.1177/1745691611429355

Chiesa, A., Serretti, A., & Jakobsen, J. C. (2013). Mindfulness: Top–down or bottom–up emotion regulation strategy? *Clinical Psychology Review*, *33*, 82–96. https://doi.org/10.1016/j.cpr.2012.10.006

Christopher, M. S., Neuser, N. J., Michael, P. G., & Baitmangalkar, A. (2012). Exploring the psychometric properties of the Five Facet Mindfulness Questionnaire. *Mindfulness*, *3*(2), 124–131. https://doi.org/10.1007/s12671-011-0086-x

Creswell, J. D., Pacilio, L. E., Lindsay, E. K., & Brown, K. W. (2014). Brief mindfulness meditation training alters psychological and neuroendocrine responses to social evaluative stress. *Psychoneuroendocrinology*, *44*, 1–12. https://doi.org/10.1016/j.psyneuen.2014.02.007

Curran, P. J., & Hussong, A. M. (2009). Integrative data analysis: The simultaneous analysis of multiple data sets. *Psychological Methods*, *14*, 81–100. https://doi.org/10.1037/a0015914

de Bruin, E. I., Topper, M., Muskens, J. G., Bögels, S. M., & Kamphuis, J. H. (2012). Psychometric properties of the Five Facets Mindfulness Questionnaire (FFMQ) in a meditating and a non-meditating sample. *Assessment*, *19*, 187–197. https://doi.org/10.1177/1073191112446654

de Wit, F. R., Scheepers, D., & Jehn, K. A. (2012). Cardiovascular reactivity to resistance to opposing viewpoints during intragroup conflict. *Psychophysiology*, *49*, 1523–1531. https://doi.org/10.1111/j.1469-8986.2012.01456.x

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin*, *130*, 355–391. https://doi.org/10.1037/0033-2909.130.3.355

Dunlop, W. L., Karan, A., Wilkinson, D., & Harake, N. (2020). Love in the first degree: Individual differences in first-person pronoun use and adult romantic attachment styles. *Social Psychological and Personality Science*, *11*, 254–265. https://doi.org/10.1177/1948550619847455

Elvery, N., Jensen, M. P., Ehde, D. M., & Day, M. A. (2017). Pain catastrophizing, mindfulness, and pain acceptance: What's the difference? *The Clinical Journal of Pain*, *33*, 485–495. https://doi.org/10.1097/ajp.0000000000000430

Fabrigar, L. R., & Wegener, D. T. (2016). Conceptualizing and evaluating the replication of research results. *Journal of Experimental Social Psychology*, *66*, 68–80. https://doi.org/10.1016/j.jesp.2015.07.009

Goh, J. X., Hall, J. A., & Rosenthal, R. (2016). Mini meta-analysis of your own studies: Some arguments on why and a primer on how. *Social and Personality Psychology Compass*, *10*, 535–549. https://doi.org/10.1111/spc3.12267

Hafner, N., Pepping, C. A., & Wertheim, E. H. (2018). Dispositional mindfulness, rejection sensitivity, and behavioural responses to rejection: The role of emotion regulation. *Australian Journal of Psychology*, *71*, 163–170. https://doi.org/10.1111/ajpy.12224

Hanley, A. W., Palejwala, M. H., Hanley, R. T., Canto, A. I., & Garland, E. L. (2015). A failure in mind: Dispositional mindfulness and positive reappraisal as predictors of academic self-efficacy following failure. *Personality and Individual Differences*, *86*, 332–337. https://doi.org/10.1016/j.paid.2015.06.033

Hase, A., O'Brien, J., Moore, L. J., & Freeman, P. (2019). The relationship between challenge and threat states and performance: A systematic review. *Sport, Exercise, and Performance Psychology*, *8*, 123–144. https://doi.org/10.1037/spy0000132

Hertz, R. M., Laurent, H. K., & Laurent, S. M. (2015). Attachment mediates effects of trait mindfulness on stress responses to conflict. *Mindfulness*, *6*, 483–489. https://doi.org/10.1007/s12671-014-0281-7

Hofmann, S. G., Heering, S., Sawyer, A. T., & Asnaani, A. (2009). How to handle anxiety: The effects of reappraisal, acceptance, and suppression strategies on anxious arousal. *Behaviour Research and Therapy*, *47*(5), 389–394. https://doi.org/10.1016/j.brat.2009.02.010

Hofmann, S. G., Moscovitch, D. A., & Kim, H. J. (2006). Autonomic correlates of social anxiety and embarrassment in shy and non-shy individuals. *International Journal of Psychophysiology*, *61*(2), 134–142. https://doi.org/10.1016/j.ijpsycho.2005.09.003

Hohaus, L. C., & Spark, J. (2013). 2672 – Getting better with age: Do mindfulness & psychological well- being improve in old age? *European Psychiatry*, *28*, 1.

Jamieson, J. P., Nock, M. K., & Mendes, W. B. (2012). Mind over matter: Reappraising arousal improves cardiovascular and cognitive responses to stress. *Journal of Experimental Psychology: General*, *141*, 417–422. https://doi.org/10.1037/a0025719

Jones, M., Meijen, C., McCarthy, P. J., & Sheffield, D. (2009). A theory of challenge and threat states in athletes. *International Review of Sport and Exercise Psychology*, *2*, 161–180. https://doi.org/10.1080/17509840902829331

Kabat-Zinn, J. (1994). *Wherever you go, there you are*. Hyperion Books.

Kassam, K. S., Koslov, K., & Mendes, W. B. (2009). Decisions under distress: Stress profiles influence anchoring and adjustment. *Psychological Science*, *20*, 1394–1399. https://doi.org/10.1111/j.1467-9280.2009.02455.x

Kee, Y. H., & Liu, Y.-T. (2011). Effects of dispositional mindfulness on the self-controlled learning of a novel motor task. *Learning and Individual Differences*, *21*, 468–471. https://doi.org/10.1016/j.lindif.2011.01.009

Kelsey, R. M., & Guethlein, W. (1990). An evaluation of the ensemble averaged impedance cardiogram. *Psychophysiology*, *27*, 24–33. https://doi.org/10.1111/j.1469-8986.1990.tb02173.x

Keng, S. L., Smoski, M. J., & Robins, C. J. (2011). Effects of mindfulness on psychological health: A review of empirical studies. *Clinical Psychology Review*, *31*, 1041–1056. https://doi.org/10.1016/j.cpr.2011.04.006

Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The "Trier Social Stress Test"—A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, *28*(1–2), 76–81. https://doi.org/10.1159/000119004. PMID: 8255414.

Kudielka, B. M., Hellhammer, D. H., & Kirschbaum, C. (2007). Ten years of research with the Trier Social Stress Test–Revisited. In E. Harmon-Jones & P. Winkielman (Eds.), *Social neuroscience: Integrating biological and psychological explanations of social behavior* (pp. 56–83). Guilford Press.

Laurent, H. K., Laurent, S. M., Nelson, B., Wright, D. B., & De Araujo Sanchez, M. A. (2013). Dispositional mindfulness moderates the effect of a brief mindfulness induction on physiological stress responses. *Mindfulness*, *6*, 1192–1200. https://doi.org/10.1007/s12671-014-0377-0

Le, P. Q., Saltsman, T. L., Seery, M., Ward, D. E., Kondrak, C. L., & Lamarche, V. M. (2019). When a small self means manageable obstacles: Spontaneous self-distancing predicts divergent effects of awe during a subsequent performance stressor. *Journal of Experimental Social Psychology*, *80*, 59–66. https://doi.org/10.1016/J.JESP.2018.07.010

Llabre, M. M., Spitzer, S. B., Saab, P. G., Ironson, G. H., & Schneiderman, N. (1991). The reliability and specificity of delta versus residualized change as measures of cardiovascular reactivity to behavioral challenges. *Psychophysiology*, *28*, 701–711. https://doi.org/10.1111/j.1469-8986.1991.tb01017.x

Lupien, S. P., Seery, M. D., & Almonte, J. L. (2012). Unstable high self-esteem and the eliciting conditions of self-doubt. *Journal of Experimental Social Psychology*, *48*, 762–765. https://doi.org/10.1016/j.jesp.2012.01.009

Lynch, J. J., Thomas, S. A., Long, J. M., Malinow, K. L., Chickadonz, G., & Katcher, A. H. (1980). Human speech and blood pressure. *Journal of Nervous and Mental Disease*, *168*(9), 526–534. https://doi.org/10.1097/00005053-198009000-00002

Manigault, A. W., Figueroa, W. S., Hollenbeck, C. R., Mendlein, A. E., Woody, A., Sinegar, S. E., . . .Zoccola, P. M. (2018). A test of the association between mindfulness subcomponents and diurnal cortisol patterns. *Mindfulness*, *9*, 897–904. https://doi.org/10.1007/s12671-017-0829-4

McFarlin, D. B., & Blascovich, J. (1984). On the remote associates test (RAT) as an alternative to illusory performance feedback: A methodological note. *Basic and Applied Social Psychology*, *5*, 223–229. https://doi.org/10.1207/s15324834basp0503_5

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton University Press.

Scheepers, D., de Wit, F., Ellemers, N., & Sassenberg, K. (2012). Social power makes the heart work more efficiently: Evidence from cardiovascular markers of challenge and threat. *Journal of Experimental Social Psychology*, *48*, 371–374. https://doi.org/10.1016/j.jesp.2011.06.014

Seery, M. D. (2011). Challenge or threat? Cardiovascular indexes of resilience and vulnerability to potential stress in humans. *Neuroscience and Biobehavioral Reviews*, *35*, 1603–1610. https://doi.org/10.1016/j.neubiorev.2011.03.003

Seery, M. D. (2013). The biopsychosocial model of challenge and threat: Using the heart to measure the mind. *Social and Personality Psychology Compass*, *7*, 637–653. https://doi.org/10.1111/spc3.12052

Seery, M. D., Blascovich, J., Weisbuch, M., & Vick, S. B. (2004). The relationship between self-esteem level, self-esteem stability, and cardiovascular reactions to performance feedback. *Journal of Personality and Social Psychology*, *87*, 133–145. https://doi.org/10.1037/0022-3514.87.1.133

Seery, M. D., Kondrak, C. L., Streamer, L., Saltsman, T., & Lamarche, V. M. (2016). Preejection period can be calculated using R peak instead of Q. *Psychophysiology*, *53*, 1232–1240. https://doi.org/10.1111/psyp.12657

Seery, M. D., Leo, R. J., Lupien, S. P., Kondrak, C. L., & Almonte, J. L. (2013). An upside to adversity? Moderate cumulative lifetime adversity is associated with resilient responses in the face of controlled stressors. *Psychological Science*, *24*, 1181–1189. https://doi.org/10.1177/0956797612469210

Seery, M. D., & Quinton, W. J. (2016). Understanding resilience: From negative life events to everyday stressors. In J. M. Olson & M. P. Zanna (Eds.), *Advances in experimental social psychology* (*Vol. 54*, pp. 181–245). Academic Press. https://doi.org/10.1016/bs.aesp.2016.02.002

Seery, M. D., Weisbuch, M., & Blascovich, J. (2009). Something to gain, something to lose: The cardiovascular consequences of outcome framing. *International Journal of Psychophysiology*, *73*, 308–312. https://doi.org/10.1016/j.ijpsycho.2009.05.006

Sherwood, A., Allen, M. T., Fahrenberg, J., Kelsey, R. M., Lovallo, W. R., & van Doornen, L. J. (1990). Methodological guidelines for impedance cardiography. *Psychophysiology*, *27*, 1–23. https://doi.org/10.1111/j.1469-8986.1990.tb02171.x

Shimizu, M., Seery, M. D., Weisbuch, M., & Lupien, S. P. (2011). Trait social anxiety and physiological activation: Cardiovascular threat during social interaction. *Personality and Social Psychology Bulletin*, *37*, 94–106. https://doi.org/10.1177/0146167210391674

Soysa, C. K., & Wilcomb, C. J. (2015). Mindfulness, self-compassion, self-efficacy, and gender as predictors of depression, anxiety, stress, and well-being. *Mindfulness*, *6*, 217–226. https://doi.org/10.1007/s12671-013-0247-1

Stanley, I. H., Boffa, J. W., Tran, J. K., Schmidt, N. B., Joiner, T. E., & Vujanovic, A. A. (2019). Posttraumatic stress disorder symptoms and mindfulness facets in relation to suicide risk among firefighters. *Journal of Clinical Psychology*, *75*(4), 696–709. https://doi.org/10.1002/jclp.22748

Steiger, J. H. (2004). Beyond the F test. Effect size confidence intervals and tests of close fit in the analysis of variance and contrast analysis. *Psychological Methods*, *9*, 164–182. https://doi.org/10.1037/1082-989X.9.2.164

Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics* (3rd ed.). Harper Collins.

Tomlinson, E. R., Yousaf, O., Vittersø, A. D., & Jones, L. (2018). Dispositional mindfulness and psychological health: A systematic review. *Mindfulness*, *9*, 23–43. https://doi.org/10.1007/s12671-017-0762-6

Turner, M. J., Jones, M. V., Sheffield, D., Slater, M. J., Barker, J. B., & Bell, J. J. (2013). Who thrives under pressure? Predicting the performance of elite academy cricketers using the cardiovascular indicators of challenge and threat states. *Journal of Sport & Exercise Psychology*, *35*, 387–397. https://doi.org/10.1123/jsep.35.4.387

van den Hurk, P. A., Janssen, B. H., Giommi, F., Barendregt, H. P., & Gielen, S. C. (2010). Mindfulness meditation associated with alterations in bottom-up processing: Psychophysiological evidence for reduced reactivity. *International Journal of Psychophysiology*, *78*, 151–157. https://doi.org/10.1016/j.ijpsycho.2010.07.002

Vine, S. J., Freeman, P., Moore, L. J., Chandra-Ramanan, R., & Wilson, M. R. (2013). Evaluating stress as a challenge is associated with superior attentional control and motor skill performance: Testing the predictions of the biopsychosocial model of challenge and threat. *Journal of Experimental Psychology: Applied*, *19*, 185–194. https://doi.org/10.1037/a0034106

Wahbeh, H., Lu, M., & Oken, B. (2011). Mindful awareness and non-judging in relation to posttraumatic stress disorder symptoms. *Mindfulness*, *2*(4), 219–227. https://doi.org/10.1007/s12671-011-0064-3

Walach, H., Buchheld, N., Buttenmuller, V., Kleinknecht, N., & Schmidt, S. (2006). Measuring mindfulness—the Freiburg Mindfulness Inventory (FMI). *Personality and Individual Differences*, *40*, 1543–1555. https://doi.org/10.1016/j.paid.2005.11.025

Westbrook, C., Creswell, J. D., Tabibnia, G., Julson, E., Kober, H., & Tindle, H. A. (2011). Mindful attention reduces neural and self-reported cue-induced craving in smokers. *Social Cognitive and Affective Neuroscience*, *8*, 73–84. https://doi.org/10.1093/scan/nsr076

Wright, C. J., & Schutte, N. S. (2013). The relationship between greater mindfulness and less subjective experience of chronic pain: Mediating functions of pain management self-efficacy and emotional intelligence. *Australian Journal of Psychology*, *66*, 181–186. https://doi.org/10.1111/ajpy.12041