Facing the Facets:

No Association Between Dispositional Mindfulness Facets and Positive Momentary Stress

Responses During Active Stressors

Thomas L. Saltsman[a*]

Mark D. Seery[a]

Deborah E. Ward[a]

Tracy M. Radsvick[a]

Zaviera A. Panlilio[a]

Veronica M. Lamarche[b]

Cheryl L. Kondrak[a]

[a]University at Buffalo, The State University of New York
Department of Psychology, Park Hall, Buffalo, NY 14260, United States

[b]University of Essex
Department of Psychology, Wivenhoe Park, Colchester, Essex, CO4 3SQ, United Kingdom

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*Corresponding author:
Tel: 716-645-0256
Email addresses:
tlsaltsm@buffalo.edu (T. L. Saltsman)
mdseery@buffalo.edu (M. D. Seery)

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

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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, Weinstein, & Creswell, 2012; Bullis, Bøe,

Asnaani, & Hofmann 2014; Hertz, Laurent, & Laurent, 2015; Laurent, Laurent, Nelson, Wright,

& De Araujo Sanchez, 2013) as well as more adaptive cognitive responses (e.g., less rumination

and pain catastrophizing) and greater psychological well-being (for reviews, see Tomlinson,

Yousaf, Vitterso, & Jones, 2018; Keng, Smoski, & Robins, 2011). 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; Wahbeh & Shutte, 2011; Soysa &

Wilcomb, 2015).

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, the current work used theory-based cardiovascular responses capable of

not only capturing the extent to which individuals care about an active stressor in the moment,

but whether they have a more positive or negative psychological experience during the stressor.

Dispositional Mindfulness and Stress

The current work draws primarily from Baer and colleagues' (2006, 2008)

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, 2008).

The overarching construct of dispositional mindfulness has been associated with various

stress and coping benefits (e.g., Tomlinson, et al., 2018; Keng, et al., 2011), 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). Further,

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, 2013).

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, Pacilio, Lindsay, and Brown (2014) argued that *high* cortisol reactivity may 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 minutes 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 non-invasive 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).

The Biopsychosocial Model of Challenge/threat (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, Weisbuch,

& Blascovich, 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., Shimizu, Seery, Weisbuch, & Lupien, 2011; Seery, Blascovich,

Weisbuch, & Vick, 2004).

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-judgement. On the other hand, 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: (1) 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; (2) 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, Palejwala, Hanley, & Canto, & Garland, 2015;

Wright & Shutte, 2013) and test performance (e.g., Bellinger, DeCaro, & Ralston, 2015; Kee &

Liu, 2011), both of which have been associated with greater relative challenge (Jones, Meijen,

McCarthy, & Sheffield, 2009; Hase et al., 2016). 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 6 samples, 1001 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; 182 in Sample 6). In a typical study with our set of

cardiovascular measures, approximately 10-15 percent of the sample may be lost due to

recording problems. Across all 6 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, 7 due to unusable electrocardiography data (2 of these due to an irregular heartbeat that impacted data processing), 16 due to missing data for the dispositional mindfulness questionnaire, and 3 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 1-3, 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. Further, because of the original hypotheses for Sample 4, only female participants whose native language was listed as English were included in this sample. Collectively, 1001 participants provides adequate power (>.80) to detect an effect size of approximately η_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 η_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 (η_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, Sample 2 and Sample 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, 5, and 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; Baer et al., 2006; Bohlijier et al., 2012) 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

dataset for analyses, and thus depart from the historical norm of presenting each individually (see

stimulus materials document for additional sample-specific procedural details).[2]

Materials

Five Facet Mindfulness Questionnaire-Short Form (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, Buchheld, Buttenmuller, Kleinknecht, &

Schmidt, 2006; Kentucky Inventory of Mindfulness Inventory, Baer, Smith, & Allen, 2004). In

the current work, we relied upon Bohlijier and colleagues' (2012) 24-item version (FFMQ-SF) to

assess mindfulness as a unitary construct ($\alpha = .804$), as well as assess each individual facet,

including observing ($\alpha = .721$), describing ($\alpha = .823$), acting with awareness ($\alpha = .797$),

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

(Bohlijier et al., 2011). In Bohlijier 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, Kneebone, & Bailey, 2018; Elvery, Jensen, Ehde, & Day, 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 1-5 Likert-type scale

(see stimulus materials document 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, Kondrak, Streamer, Saltsman, & Lamarche, 2016; also see

Lupien, Seery, & Almonte, 2012; Shimizu et al., 2011), including ensemble averaging in 60s

intervals (Kelsey & Guethlein, 1990). This approach is comparable to techniques used in other challenge/threat work with different equipment configurations (e.g., de Wit, Scheepers, & Jehn, 2012; Jamieson, Nock, and Mendes, 2012; Kassam, Koslov, & Mendes, 2009; Turner et al., 2013; Vine, Freeman, Moore, Chandra-Ramanan, & Wilson, 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 1kHz. 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 1kHz. The blood pressure monitor was wrist-mounted, collecting continual readings (every 10-15 seconds) 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 1-3 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 two minutes to give a speech on a specific topic (e.g., a current

obstacle or setback). Participants were encouraged to use the full two minutes 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 15s to generate an answer before the presenting computer advanced to

the next item (3min 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, Pirke, & Hellhammer, 1993). The TSST

has been used in over 4000 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 HPA and SAM (sympathoadrenal medullary) axis and

cardiovascular and immunological systems (see Kudielka, Hellhammer, & Krischbaum, 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; CITATION BLINDED,

2019; Seery, et al., 2009; Lynch, Thomas, Long, Malinow, Chickadonz, & Katcher, 1980), but

also state anxiety (Hoffmann, Heering, Sawyer, & Asnaani, 2009), as well as other stress-related

emotions such as fear and embarrassment (Hofmann, Moscovich, & Kim, 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, Mendes, Hunter, & Salomon, 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, Karan, Wilkinson, & Harare, 2019), 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, Thoemmes, & Rosenthal, 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, Leo, Lupien, Kondrak, & Almonte, 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, Spitzer, Saab, Ironson, & Schneiderman, 1991, for psychometric justification for the use of change scores in psychophysiology). In order 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 (1) HR and VC and (2) TPR and CO should reflect the same

underlying physiological activation and indicate relative differences in (1) task engagement and

(2) challenge/threat, respectively. As is standard practice (e.g., Blascovich, Seery, Mugridge,

Norris, & Weisbuch, 2004; de Wit, Scheepers, & Jehn, 2012; Seery, Weisbuch, & Blascovich,

2009), cardiovascular measures were combined into task engagement (HR and VC) and

challenge/threat (TPR and CO) indices in order to (1) maximize the reliability of the

cardiovascular measures, analogous to averaging over multiple items on a self-report scale; and

(2) 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 versus 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 $< .001$, $d=0.44$.

Further, testing this association across the entire collective sample yielded the same

interpretation for heart rate, $t(1000)=37.54$, $M=8.59$, $p<.001$, $d=1.19$. and ventricular

contractility, $t(1000)=16.55$, $M=4.78$, 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): (1) 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; (2) 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, $b=0.068$, $t(994)=2.16$, $p=.031$, $\eta_p^2=.005$, 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, $b=0.095$, $t(994)=3.02$, $p=.003$, $\eta_p^2=.009$, 90% CI

[.002, .021]. No other individual mindfulness facets significantly predicted task engagement,

*b*s<0.047, *t*s<1.50, *p*s>.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.

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	-.096*	.064	-.108*	-.070	-.020	-.099*	-						
Dispositional Mindfulness													
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	.997	180.268	1.559	.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. $N = 1001$ for all data

except self-report ($N = 496$).

$^*p < .05.$ $^{**}p < .01.$ $^{***}p < .001$

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, $b=0.245$, $t(495)=5.19$, $p<.001$, $\eta_p^2=.052$, 90% CI [.024, .086]. Further, 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" on these standardized

scores. This analysis revealed a significant interaction, b=0.286, 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, rs<.048,

zs<1.49, ps>.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, rs<.03, zs<1.02, ps>.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.

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	.079	.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.

+$p < .1$ *$p < .05$. **$p < .01$. ***$p < .001$.

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. Further, we also assessed a range of demographic measures across samples, including age, gender, race/ethnicity, native language, and country of origin (See Stimulus Materials, 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, $b=.092$, $t(485)=1.85$, $p=.065$.

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 & Shutte, 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., 2018; 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, Janssen, Giommi, Barendregt, & Gielen, 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, Serretti, and

Jakobsen (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 the current 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; Boehlijir et al., 2011; Christopher, Neuser, Michael,

& Baitmangalker, 2012; de Bruin, Topper, Muskens, Bogels, & Kamphuis, 2012), but have

noted that such relationships tend to occur among meditation naïve participants. Additionally, in

two of the six samples in the current 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 is 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. 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.

　　　　The current work relied exclusively on one assessment of mindfulness: The FFMQ-SF

(Bohlijuer et al., 2012). 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.

Conclusions

Despite research touting mindfulness' various benefits for stress and coping, the current

work found little to no evidence of such an association for responses *during* active stressors.

Across six psychophysiological samples (*N*=1001), 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 the current work, we conceptualized active stressors as motivated performance tasks

in which individuals must carry out instrumental behaviors in order 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 the current 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, the current 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.

Footnotes

1. Sample 6 is the only sample containing previously published data. CITATION
   BLINDED (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: 1 value for
   HR, 3 values for VC, 3 values for CO, 3 values for TPR; Sample 2: 0 values for HR, 3
   values for VC, 1 value for CO, 5 values for TPR; Sample 3: 4 values for HR, 5 values for
   VC, 2 values for CO, 4 values for TPR; Sample 4: 2 values for HR, 2 values for VC, 2
   values for CO, 3 values for TPR; Sample 5: 2 values for HR, 3 values for VC, 3 values
   for CO, 3 values for TPR; Sample 6: 1 for HR, 1 for VC, 1 for CO, and 4 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]. Further, 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, η_p^2<.003.

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