The Effect of Trait Mindfulness on Acute Stress is Gender and Affect Dependent

Master’s Thesis

Presented to

The Faculty of the Graduate School of Arts and Sciences
Brandeis University
Department of Psychology
Jutta M. Wolf, Advisor

In Partial Fulfillment
of the Requirements for

Master’s Degree

by

Eve A. Saucier

August, 2011
ABSTRACT

The Effect of Trait Mindfulness on Acute Stress is Gender and Affect Dependent

A thesis presented to the Department of Psychology

Graduate School of Arts and Sciences
Brandeis University
Waltham, Massachusetts

By Eve A. Saucier

Stress in excess can ultimately lead to poor health outcomes. Most research on the reduction of stress via mindfulness focuses on mindfulness-based training and therapy rather than studying the effects of trait mindfulness. Like practiced mindfulness, trait mindfulness is hypothesized to reduce chronic stress and both psychological (self-report) and physiological responses to acute stress. 29 participants (16 male) were assessed for trait mindfulness, experienced the Trier Social Stress Test (TSST), and completed stress-related questionnaires. Multiple regressions revealed gender-independent negative associations between trait mindfulness and self-reported chronic and acute stress. The mindfulness and self-reported acute stress relationship was mediated by state affect. For men only, high trait mindfulness was correlated with greater cortisol increases to stress. The gender and mindfulness interaction effect on cortisol increases was only apparent when controlling for affect. Trait mindfulness is an effective protector against perceived chronic and acute stress which may correlate to positive health outcomes. The findings
in relation to cortisol may represent an adaptive response to threat in men, but cannot yet be determined in women. Further implications and limitations are also discussed.

*Keywords*: mindfulness, acute stress, gender differences, negative affect
Contents

Introduction......................................................................................................................1
Method.............................................................................................................................6
  Participants....................................................................................................................6
  Design..........................................................................................................................6
  Procedure....................................................................................................................6
  Materials.....................................................................................................................7
  Analytical Plan..........................................................................................................9
Results............................................................................................................................11
  Preliminary Analyses................................................................................................11
  Testing of Hypotheses...............................................................................................12
Discussion.....................................................................................................................14
  Application................................................................................................................17
  Limitations................................................................................................................18
  Conclusion................................................................................................................19
Tables and Figures.........................................................................................................20
References......................................................................................................................27
Tables and Figures

Table 1

*Questionnaire Scores and Stress Responses (Means and Standard Deviations) Split by Gender*

Table 2

*Pearson Correlations of Testing Parameters*

Table 3

*Regression Models for Effects of Parameters on Acute Stress Measures*

Figure 1

*Salivary Free Cortisol by Time Split by Gender*

Figure 2

*Trait Mindfulness and Self-Reported Chronic Stress*

Figure 3

*Trait Mindfulness and Self-Reported Acute Stress*

Figure 4

*Gender and Mindfulness Interaction Effect on Cortisol Increase*
The Effect of Trait Mindfulness on Acute Stress is Gender and Affect Dependent

The path from experiencing to responding to a stressful event is regulated by many factors. One moderator that has received increasing attention over the last decade is mindfulness. Mindfulness is an enduring personality trait that, in combination with others, encompasses self-compassion. Mindfulness is arguably the most important aspect of self-compassion, for one cannot adopt a kind self-attitude without first having a mindful perspective. Mindfulness is an objective, observational, and nonjudgmental way of viewing internal thoughts and external events. Attentional awareness to thoughts, feelings, and attitudes with simple acknowledgment rather than repression, overidentification, and cognitive appraisal is considered to be a mindful attitude (Kabat-Zinn, 1982; Neff, 2003; S. L. Shapiro, Brown, Thoresen, & Plante, 2011). Interestingly, mindfulness is not only a personality trait, but can be practiced and enhanced via therapy. Practiced mindfulness, as explained below, seems to affect our perception and bodily response to stress. Could trait mindfulness also protect us from harmful consequences of stress?

Stress is both a psychological and physiological response to difficult or overwhelming events. Acute stress, such as an exam or test, refers to an isolated event in which threat is perceived. Chronic stress, such as dealing with an illness or death, can last for years on end. Importantly, chronic stress may lead to poor health outcomes such as decreased immune function, heart disease, depression and anxiety (Kemeny, 2003; McEwen, 1998; Miller & Blackwell, 2006). Furthermore, poorly managed or multiple acute stress exposures can build up over time, resulting in harmful chronic stress
including the described health consequences (McEwen, 1998). For example, where one exam might be manageable, an overwhelming semester or finals period can leave one exhausted and sometimes sick, due to decreased immune function from the enduring stress (Kemeny, 2003).

There is a physiological component linking perceived self-reported stress to health effects. More specifically, the hypothalamic-pituitary-adrenal (HPA) axis is one of two stress pathways of the body next to the sympathetic nervous system. When a threat is perceived, a cascade of hormones is activated, the end result of which is cortisol. Cortisol levels peak 20-30 minutes after stressor onset, which is much slower than the fast-acting sympathetic system. Cortisol both supports and mediates the defensive stress response via a feedback loop so that the body does not over-respond to the stress. This increase in cortisol levels from before the stressor to 20-30 minutes post stressor is thus an established measure of the physiological stress response. However, as a result of chronic stress, the body may no longer respond the same way to acute stress events, which then can result, for example, in failure to down-regulate inflammatory pathways activated by the acute stress event (Miller et al., 2008). This can ultimately result in illness such as depression and heart disease (Miller & Blackwell, 2006) as well as decreased memory function (Lupien & Nair, 1998).

With regard to mindfulness, a new type of therapy, utilizing practiced mindfulness, has been shown to reduce negative effects of stress at both acute and chronic levels. More specifically, mindfulness-based stress reduction (MBSR), developed from mindfulness meditation of Buddhist principles, can increase practiced mindfulness
by regulating attention and awareness resulting in a “detached self-observation” (Kabat-Zinn, 1982; S. L. Shapiro et al., 2011). Chronic stress and stress-related health conditions can be relieved by practiced mindfulness. Sensations of chronic pain, tendencies to catastrophize, and chronic stress associated with illnesses such as breast cancer are all examples of conditions relieved by MBSR and similar training (Cusens, Duggan, Thorne, & Burch, 2010; Kabat-Zinn, 1982). Other studies have found that MBSR decreases depression and anxiety, both of which can develop from chronic stress, in both healthy and clinical populations (Hofmann, Sawyer, Witt, & Oh, 2010; Kabat-Zinn, 1982).

While the above studies show that practiced mindfulness can help alleviate conditions linked to chronic stress, the question arises whether practiced mindfulness also plays a preventive role in that it can change responses to acute stress events. As repeated acute stress can culminate in undesirable health outcomes by becoming chronic stress, reducing the occurrence of acute stress responses by changing the perception of a potentially stressful event may be protective against these conditions.

Some (indirect) evidence exists suggesting that practiced mindfulness can indeed be effective in protecting against and curbing acute stress responses. This type of mindfulness has been shown to decrease negative mood and increase positive mood both generally and in response to distressing film clips (Davidson et al., 2003; Erisman & Roemer, 2010; Tang et al., 2007). Furthermore, increases in brain activation in areas associated with positive affect in response to writing about positive and negative experiences have been documented following MBSR training (Davidson et al., 2003). The magnitude of MBSR’s increases in positive affect brain activation subsequently correlated to the increase of influenza antibodies in response to a vaccine (Davidson et al.,
2003). Furthermore, in response to a psychosocial lab stressor, practiced mindfulness has been shown to be correlated with decreased levels of interleukin-6, an immune mediator which typically increases with stress (Pace, 2009). In addition, meditation training that included mindfulness practice correlated with lower cortisol stress responses to a cognitive challenge (Tang et al., 2007). In summary, the above findings suggest that increasing mindfulness indeed has desirable effects when it comes to dealing with acute stress.

While research so far mostly focused on the effects of manipulating practiced mindfulness, an interesting and understudied question is whether or not trait mindfulness itself can decrease or protect against self-reported and physiological acute stress effects as well. Chronic stress and related health problems may be relieved by trait mindfulness such that high trait mindfulness seems to be protective against mental illness, primarily post-traumatic stress disorder, and is associated with lower levels of psychopathology (Bernstein, Tanay, & Vujanovic, 2011). But what is the relationship between trait mindfulness and acute stress perception and physiological responses? Examining effects of mindfulness on self-reported stress as well as physiological responses to stress may provide a more comprehensive picture of the mindfulness-stress relationship.

Lastly, the current literature suggest that several factors may influence the mindfulness-stress relationship, most importantly, gender. Overall, men show stronger cortisol responses to acute stress than age-matched women between puberty and menopause (Kajantie & Phillips, 2006). Furthermore, salivary cortisol measurements determined that women show a greater stress response when they experience social rejection, whereas men show a greater stress response to achievement challenges (Stroud
et al., 2002). Interestingly, this does not seem to be due to differences in positive or negative affect (Watson, 1988). However, some evidence exists suggesting that post-stress, women seem to have greater decreases in happiness and more irritability and fear (Kelly, Tyrka, Anderson, Price, & Carpenter, 2008). Women are also more likely to develop long-term conditions such as depression and anxiety that are often associated with stress (Kelly et al., 2008). With regard to gender-difference in mindfulness, Neff (2003) found when developing the self-compassion scale, that men had higher levels of self-compassion and more specifically mindfulness, than women. To summarize, it appears that women are both less likely to be mindful and more subject to negative effects of acute stress. Hence, if mindfulness can protect against negative stress responses, it will be important to also determine if mindfulness does so in a gender-specific manner.

In summary, the current study had three aims: First, we aimed to confirm earlier indirect findings that trait mindfulness is associated with lower levels of chronic stress assessed by self-report. Second, we aimed to test our hypothesis that high trait mindfulness is associated with reduced responses to acute psychosocial stress, assessed via both self-report and cortisol. Thirdly, we predicted that gender will differentially affect the relationship between mindfulness and acute stress responses, such that men will tend to have higher levels of trait mindfulness than women as well as lower cortisol stress responses and lower self-reported acute and chronic stress.
Method

Participants

A sample of N=37 participants was recruited, however, eight participants had to be excluded from analyses due to incomplete cortisol data (n=7) or incomplete questionnaire data (n=1) resulting in N=29 participants (16 male, age: 21.86±4.38). This study was part of a larger study spanning over three days, which was approved by the Brandeis University Institutional Review Board. Participants were compensated with $100 for completion of the whole study.

Design

The level of trait mindfulness in each participant acts as the independent variable. Cortisol response and self-reported acute and chronic stress are the dependent variables. Emotional affective response to the TSST is a secondary variable used for control. This study is a correlational between-subjects design.

Procedure

After arriving in the laboratory on the second day (consent was given on day 1), the participants were asked to complete several questionnaires assessing their chronic stress levels and mindfulness levels (see below for details on questionnaires). After a 20 minute resting period, a first saliva sample for cortisol assessment was taken using a Salivette sampling device. For this, the participant was asked to place a sterile cotton roll into his/her mouth until it was saturated with saliva. The cotton roll was then placed back into the sampling device. Subsequently, the participant was brought to a second room
equipped with a microphone and camera set up in front of two lab members in white lab coats. This two person panel, the participant is told, will be evaluating the participants’ verbal and nonverbal behavior throughout the following task. After the instructions, the participant filled out a questionnaire assessing their appraisal of the situation and then immediately completed the Trier Social Stress Test (TSST; Kirschbaum Pirke, & Hellhammer, 1993) in front of the panel and camera. This test combines a mock-interview speech task and a math task. Immediately after the TSST, participant gave a third saliva sample and filled out a questionnaire assessing current mood. Additional saliva samples were collected 10, 30, 60, and 120 minutes after TSST). After completion of the study, i.e., after day 3, the participant received the honorarium.

**Materials**

**Questionnaires.** For the current study, the Self-Compassion Scale, Perceived Stress Scale, Positive and Negative Affect Schedule, and Primary Appraisal and Secondary Appraisal Scale were used.

Trait mindfulness was assessed by the mindfulness subscale of the Self-Compassion Scale (SCS; Neff, 2003) which contains a total of 6 subscales: self-kindness, self-judgment, common humanity, isolation, overidentification, and mindfulness. The SCS contains 26 items asking participants to rate the listed thoughts and behavior such as “I’m kind to myself when I’m experiencing suffering” and “When I fail at something important to me I become consumed by feelings of inadequacy” according to the frequency that they occur for that individual. The SCS uses a 5-point Likert scale ranging from 1- almost never, to 5- almost always. The mindfulness subscale consists of 4 items and has a Cronbach’s alpha of .75. A high score on this subscale (closer to 20) means the
participant is more mindful, whereas a low score (closer to 4) indicates less trait mindfulness.

The Perceived Stress Scale (Cohen, 1983) is a 10-item questionnaire that assesses the participants’ perceived stress level in various situations from the previous month. Questions such as “In the last month, how often have you felt that you were unable to control the important things in your life?” are rated from 0-4, where 0 equals “Never” and 4 equals “Very often.” Chronbach’s alpha is .85 for this scale. Greater perceived stress is marked by a high score on this scale. Scores range from 0 to 40.

We assessed affect following the TSST using the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988). Items such as “afraid” “hostile” and “jittery” make up the 10-item negative affect subscale with a Cronbach’s alpha of .85 whereas items such as “determined” “proud” and “strong” make up the 10-item positive affect subscale with a Cronbach’s alpha of .88. Each item is thereby rated on a 5-point Likert scale ranging from 1- very slightly or not at all to 5- extremely based on the participant’s current emotions. A high negative subscale score indicates more negative affect and a high positive affect subscale score indicates more positive affect (scores near 50). A low score near 10 is reminiscent of less positive or negative affect. It is possible to have high levels of both positive and negative affect or low levels of positive and negative affect, just as it is possible to be high in one subscale and low in the other.

Acute self-reported stress was measured by the Primary Appraisal and Secondary Appraisal Scale (PASA; Gaab, Rohleder, Nater, & Ehlert, 2005). The PASA consists of 16 items which gather scores for primary appraisal (containing both “threat” and “challenge” assessments; α=0.80), and secondary appraisal (containing both “self-
concept of own abilities” and “control expectancy” assessments; $\alpha=0.74$). Participants rate items on a scale from 1 – strongly agree to 6 – strongly disagree. Finally, a stress index is calculated using the appraisal scales to determine overall if the individual feels they can handle the upcoming event.

**Serological analyses of cortisol.** Saliva was collected using salivettes (Sarstedt, Nunbrecht, Germany). Samples were stored at -30C until analysis. After completion of the study, samples were thawed and centrifuged for 10min at 1000g. Free cortisol levels were determined by a commercially available chemiluminescence assay (IBL, Canada).

**Analytical Plan**

All of the variables were treated as continuous variables. We first computed descriptive statistics on all parameters, i.e., the independent variable (IV) trait mindfulness, the dependent variables (DV) cortisol responses and self-reported acute (PASA) and chronic stress (PSS), as well as the secondary IV emotional affective response (PANAS). T-tests were computed for all of these parameters to test for gender differences. Furthermore, preliminary analyses regarding cortisol stress responses consisted of a repeated measure ANOVA with 6 within-subject levels as well as gender as a between-subject factor testing for changes in cortisol levels over time as well as whether those changes would be gender-specific. For later regression analyses, a cortisol stress response index was computed by subtracting baseline cortisol levels from maximum cortisol level post-TSST, such that a greater score is indicative of a greater cortisol stress response to the TSST. Furthermore, bivariate correlations were computed between the secondary IV (PANAS) and all other measures as well as between the various stress measures (max cortisol increase, PASA, PSS).
To test our hypotheses linking trait mindfulness to self-reported acute and chronic stress as well as cortisol stress responses, several multiple linear regressions were computed using recommended procedures for testing interaction effects (Aiken & West, 1991). Stress measures (max cortisol increase, PASA, PSS) were thereby the outcome variables of separate regressions, while trait mindfulness (centered), gender, as well as gender-by-mindfulness were the predictors and all entered at the same level. Our predictions thereby translate into significant main effects of trait mindfulness for all three measures of stress as well as three significant trait-mindfulness-by-gender effects, suggesting the trait mindfulness effects to be gender-specific. Finally, we added both PANAS subscales to control for any possible effects of state affect on the relationship between mindfulness and stress.
Results

Preliminary Findings

Mean scores for all measured parameters as well as statistics on potential gender differences can be found in Table 1. However, no gender differences in trait mindfulness or stress measures as well as affect were found (all $p > .35$). Bivariate correlations revealed a significant negative relationship between mindfulness and negative affect ($r = -.465$, $p = .001$), indicating that stronger trait mindfulness was associated with reporting less negative affect. Furthermore, negative affect was significantly positively associated with measures of stress (PSS: $r = .630$, $p < .001$; PASA: $r = .709$, $p < .001$), such that participants who scored high on negative affect also scored high on self-reported chronic and acute stress. Lastly, a significant positive relationship also existed between self-reported chronic and acute stress levels ($r = .531$, $p = .004$; for a summary of all correlations see Table 2).

With regard to overall cortisol responses, we found significant changes in levels over time (time: $F = 9.450$, $p < .001$; time-by-gender: $F = 1.635$, $p = .141$) as well as a gender main effect ($F = 5.743$, $p = .024$), such that all participants showed a strong increase in cortisol levels shortly after the TSST and subsequent decreases with females showing overall lower levels (see Figure 1). Next, we computed cortisol increases as described and although we found great variations among participants, with values ranging from -7.11 to 19.83 nmol/l (mean=2.37 nmol/l), male and female participants did not differ ($t = .586$, $p = .563$).
Testing of Hypotheses

To determine if, similar to practiced mindfulness, trait mindfulness was associated with lower levels of chronic stress as well as whether this association was gender-dependent, we computed a multiple linear regression. The regression revealed a significant negative association between mindfulness and chronic stress ($\beta = -.783, p<.001$) indicating that participants high on trait mindfulness reported lower levels of perceived chronic stress. This association was not gender dependent (gender: $\beta = .116, p = .392$; see Figure 2). Controlling for affect, the relationship between mindfulness and chronic stress remained significant ($\beta = -.454, p = .039$).

Next, we computed similar regressions for self-reported acute stress and found a significant relationship between trait mindfulness and scores on the PASA ($\beta = -.664, p = .010$), such that high trait mindfulness scores were associated with participants reporting less perceived acute stress following the TSST (see Figure 3). However, when repeating the analysis for our physiological stress measure, trait mindfulness did not predict cortisol responses to acute stress ($\beta = .077, p = .774$). Furthermore, in both regression analyses, no gender-dependent effects of mindfulness on stress measures were found (gender-by-mindfulness: all $p > .35$).

Since the current mood a participant was in might have affected how stressful he/she perceived the TSST, we repeated the above analyses controlling for PANAS scores (both the negative and the positive subscale). When taking current mood into account, the relationship between mindfulness and self-reported stress (PASA) diminished ($\beta = -.095, p = .694$), however, it also revealed a trend toward a gender-dependent effect of mindfulness on participants’ cortisol increases ($\beta = -.529, p = .069$).
showing that when accounting for current emotional state, females in general and males with low mindfulness all showed similar cortisol increases. Males with high mindfulness, however, differed in that they showed greater cortisol increases than all other groups (see Figure 4).

Lastly, we tested whether any of the above findings would change when considering age, however, age turned out to not be an important moderating factor in the current study population.
Discussion

The goal of this study was to determine trait mindfulness’s effect on acute stress responses. We expected that high trait mindfulness would be negatively associated with both perceived stress and cortisol stress responses, and that these associations would be gender-dependent. Firstly, we were able to confirm that trait mindfulness is negatively associated with chronic stress. However, this association was true for both male and females. Furthermore, the negative relationship between trait mindfulness and self-reported acute stress was completely mediated by current mood, i.e., no longer present when controlling for current mood. Interestingly, however, only when taking current mood into account, a gender-dependent relationship between trait mindfulness and cortisol increases was revealed. This relationship showed that males high on trait mindfulness exhibited the strongest cortisol stress responses, indicating that males’ cortisol increases were dependent on mindfulness, while females’ were not.

As expected, we found self-reported chronic stress to be negatively correlated with trait mindfulness regardless of gender. This prediction was based on research connecting practiced mindfulness to reductions in stress-related conditions such as chronic pain and stress associated with cancer (Cusens et al., 2010; Kabat-Zinn, 1982). However, the current finding suggests that trait mindfulness itself may be a protective factor reducing not only perception of chronic stress, but health risks associated with chronic stress. Interestingly, although we predicted gender differences in this association based on the increased likelihood of females to develop chronic stress-related health
problems, the literature on MBSR and these complications either ignores possible gender effects or finds none (Cusens et al., 2010; Hofmann et al., 2010; Kabat-Zinn, 1982; Kelly et al., 2008) thus being in line with our own findings. This suggests that trait mindfulness exerts its effects on perceived chronic stress conditions similarly for both male and females.

Interestingly, high mindfulness also was associated with less self-reported acute stress, suggesting that high trait mindfulness may at least to a certain extent act as a stress protective factor by reducing the occurrence of perceived acute stress. Again, repeated acute stress can culminate into chronic stress and result in negative health outcomes. Thus, curbing acute stress may have long-term health benefits (McEwen, 1998). Mindfulness is an acceptance of one’s emotion and feeling, without trying to change it or judge oneself. The TSST may pose less of a threat to those that are mindful (Weinstein, Brown, & Ryan, 2009). Also, mindful individuals have been found to use less avoidant coping strategies and are more accepting of the threat (Weinstein et al., 2009). Practiced mindfulness, as mentioned, has positive outcomes on acute stress, affect, and even the immune response (Davidson et al., 2003; Pace, 2009). Trait mindfulness seems to follow this pattern and may go so far as to correlate to more adaptive immune responses. However, when controlling for affective state, the relationship between mindfulness and perceived stress ceased to exist. This, along with the correlations among negative affect and mindfulness and self-reported acute stress, suggests that negative affect is mediating the relationship between mindfulness and acute self-reported stress. In other words, individuals high on trait mindfulness show less negative affect in response to stress and thus perceive the situation as less stressful. This interpretation is supported by recent
findings also showing that negative affect is negatively associated with trait mindfulness, which was interpreted along the same lines, i.e., as indication that mindfulness may increase the ability to remain in the present moment and not be weighted down by negative feelings (Arch & Craske, 2010). Our findings thus help understand the pathways by which trait mindfulness can exert its stress protective effect, more specifically, that trait mindfulness may reduce perception of acute stress by modulating an individual’s mood.

Lastly, we found that only when controlling for current mood, male’s cortisol responses were influenced by mindfulness levels, while females’ were not. This finding has several implications. First, it suggests that negative affect masked the effects of trait mindfulness on cortisol stress responses. This is contrary to what we found for self-reported perceived acute stress (see above). Furthermore, cortisol stress responses to the TSST were greater with higher trait mindfulness, which not only is opposite to what we predicted, but also again to what we found for self-reported acute stress. One explanation for this finding may lay in the fact that a cortisol increase to a stressful event is first and foremost considered an adaptive response. Once activated, the concerted release of stress hormones from both stress axes (SNS/SAM and HPA) help the body to deal with the situation. For example, the timed releases of catecholamines and cortisol promote changes that foster an adaptive immune response to threat (Atanackovic et al., 2006; Fleshner, Sharkey, Nickerson, & Johnson, 2007). Hence, if an individual interprets a situation as stressful, it is beneficial to actually mount a cortisol stress response in addition to the SNS response. That individuals high on trait mindfulness do so to an even larger extent may then be interpreted again as a beneficial effect of trait mindfulness on acute stress responses. Furthermore, integrating the two findings, one can speculate that
trait mindfulness on the one hand may reduce the likelihood of an individual to interpret a situation as stressful, while on the same time, supports an adaptive physiological stress response once the individual does interpret a situation as stressful. Both effects thereby can be considered health beneficial, either by reducing the occurrence of stress or by optimizing how the body deals with it.

However, with regard to cortisol stress responses, this was only true for males, while for females, trait mindfulness was not associated with cortisol stress responses. Importantly, we found no gender differences in the association between trait mindfulness and self-reported stress, and furthermore, a trend to females showing blunted cortisol stress responses compared to men. This makes it likely that we may just have missed an effect of trait mindfulness on cortisol stress responses for females due to factors, such as menstrual cycle phase, which are known to influence cortisol stress responses over and above any psychological factors (Kajantie & Phillips, 2006). Unfortunately, we were not able to confirm the women’s cycle phase in the current study, hence, the lack of an effect of trait mindfulness in this population has to be interpreted with caution.

Application

As MBSR works best with those who already have higher trait mindfulness (Shapiro et al., 2011), assessing trait mindfulness would be an important way to tailor MBSR and similar treatments to participants’ needs. The therapy would not be helpful in those with low trait mindfulness who have a dampened ability to ward off stress in this way, and assessing mindfulness would have high predictive power of who may benefit most from MBSR to reduce chronic stress-related problems. However, because those
with high trait mindfulness are already less likely to develop these problems, other treatments for those with low mindfulness should be researched.

**Limitations**

The current study has several limitations.

As mentioned above, females’ cortisol stress responses may have been influenced by menstrual cycle phase, hampering the interpretation of the gender-dependent effect of trait mindfulness on cortisol stress responses. Future studies should control for cycle phase or only assess females in their luteal phase (Kajantie & Phillips, 2006).

Furthermore, findings should be interpreted with caution because of the small sample size, which is particularly a problem in the context of using more complex regression models. In addition, all participants were college students and age did not vary significantly. Hence it is unclear to what extent our findings apply to other age groups.

Also, it would interesting to replicate the current findings using a different measure of mindfulness. We used a subscale of the Self-Compassion Scale (SCS), which is a reliable and valid measure, however, a questionnaire assessing specifically mindfulness using a larger number of items may provide a better measure of trait mindfulness in the participants.

Lastly, the relationship between mindfulness and self-reported stress may, in part, be explained by factors other than negative affect, such as decreased rumination or less post-traumatic avoidance symptoms (Bränström, Kvillemo, Brandberg, & Moskowitz, 2010; S. L. Shapiro, Brown, K. W., & Biegel, G. M. , 2007). Future studies should consider including such mediating factors, specifically those that could be increased via therapy to assist low-mindfulness individuals reduce perceived stress.
Conclusion

In conclusion, this study provides evidence that trait mindfulness is associated with reduced self-reported stress, both chronic and acute. This is consistent with literature on practiced mindfulness, implying that the two share valuable qualities that may protect against undesirable health outcomes that result from repeated unmanaged stress.

Furthermore, with regard to acute stress perception, trait mindfulness may exert its effects by positively influencing current mood, which then reduces the likelihood of interpreting a situation as a threat. This provides us with a first hint towards understanding the pathway underlying the mindfulness-stress link.

The relationship between trait mindfulness and cortisol stress responses showed a positive association in men, but no association in women. This may actually be indicative of an adaptive response to threat in men, such that once a situation has been interpreted to be threat, men show an appropriate strong physiological response. If a similar association exists for females has yet to be determined.
Table 1

*Questionnaire Scores and Stress Responses (Means and Standard Deviations) Split by Gender*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Females (N=13)</th>
<th>Males (N=16)</th>
<th>Total (N=29)</th>
<th>t (p)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>21.46 (2.99)</td>
<td>22.19 (5.33)</td>
<td>21.86 (4.38)</td>
<td>.437 (.665)</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>14.62 (3.10)</td>
<td>14.81 (2.99)</td>
<td>14.72 (2.99)</td>
<td>.174 (.863)</td>
</tr>
<tr>
<td>PANAS-Negative Affect</td>
<td>24.77 (9.32)</td>
<td>22.63 (9.94)</td>
<td>23.59 (9.56)</td>
<td>-.594 (.558)</td>
</tr>
<tr>
<td>PANAS-Positive Affect</td>
<td>27.31 (7.11)</td>
<td>27.81 (7.83)</td>
<td>27.59 (7.39)</td>
<td>.180 (.859)</td>
</tr>
<tr>
<td>PSS: Chronic Stress</td>
<td>18.62 (7.51)</td>
<td>16.50 (7.87)</td>
<td>17.45 (7.65)</td>
<td>-.734 (.469)</td>
</tr>
<tr>
<td>PASA: Acute Reported Stress</td>
<td>-1.33 (2.64)</td>
<td>-.4167 (2.41)</td>
<td>-0.8393 (2.51)</td>
<td>.956 (.348)</td>
</tr>
<tr>
<td>Cortisol Increase</td>
<td>1.53 (5.88)</td>
<td>3.04 (7.59)</td>
<td>2.37 (6.80)</td>
<td>.586 (.563)</td>
</tr>
</tbody>
</table>

*Note.* Data are the means of each parameter. Standard deviation is in parentheses. 
PANAS= Positive and Negative Affect Schedule; PSS= Perceived Stress Scale; PASA= stress index of the Primary Appraisal and Secondary Appraisal Scale. 
*a* Data are from an independent samples t-test assessing gender differences within the parameters.
### Table 2

**Pearson Correlations of Testing Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Age</th>
<th>Negative Affect</th>
<th>Positive Affect</th>
<th>Chronic Stress</th>
<th>Acute Reported Stress</th>
<th>Cortisol Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANAS- Negative Affect</td>
<td>-.284</td>
<td>-.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.136)</td>
<td>(.136)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PANAS- Positive Affect</td>
<td>.189</td>
<td>-.262</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.326)</td>
<td>(.169)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS: Chronic Stress</td>
<td>.138</td>
<td>.630</td>
<td>-.191</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.474)</td>
<td>(.000)**</td>
<td>(.322)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PASA: Acute Reported Stress</td>
<td>-.123</td>
<td>.709</td>
<td>-.254</td>
<td>.531</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.533)</td>
<td>(.000)**</td>
<td>(.193)</td>
<td>(.004)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cortisol Increase</td>
<td>.235</td>
<td>.302 (.111)</td>
<td>-.112</td>
<td>.283</td>
<td>.313</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.219)</td>
<td>(.111)</td>
<td>(.562)</td>
<td>(.137)</td>
<td>(.105)</td>
<td></td>
</tr>
</tbody>
</table>

*Note:* Data are Pearson correlation coefficients ($r$) with p-values in parentheses. PANAS = Positive and Negative Affect Schedule; PSS = Perceived Stress Scale; PASA = stress index of the Primary Appraisal and Secondary Appraisal Scale.  
*p<.05, **p<.01
Table 3

*Regression Models for Effects of Parameters on Acute Stress Measures*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>PSS: Chronic Stress</th>
<th>PASA: Acute Reported Stress</th>
<th>Cortisol Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>PANAS-Negative Affect</td>
<td>.407 (.017)*</td>
<td>.673 (.001)***</td>
<td>.545 (.031)**</td>
</tr>
<tr>
<td>PANAS-Positive Affect</td>
<td>.006 (.962)</td>
<td>-.073 (.619)</td>
<td>.018 (.924)</td>
</tr>
<tr>
<td>Gender</td>
<td>.116 (.392)</td>
<td>-.201 (.259)</td>
<td>-.249 (.089)</td>
</tr>
<tr>
<td>Mindfulness</td>
<td>-.783 (.000)**</td>
<td>-.454 (.039)*</td>
<td>-.095 (.694)</td>
</tr>
<tr>
<td>Gender By Mindfulness</td>
<td>.073 (.690)</td>
<td>-.136 (.470)</td>
<td>.050 (.817)</td>
</tr>
</tbody>
</table>

*Note.* Data are the standardized beta coefficients (βs). Significance level is in parentheses. PANAS = Positive and Negative Affect Schedule; PSS = Perceived Stress Scale; PASA = stress index of the Primary Appraisal and Secondary Appraisal Scale. *p is trending toward significance at the α=.05 level, **p<.05, ***p<.01
Figure 1. Means of participants’ cortisol responses at each saliva sample time point, separated by gender. The upper line is the average male cortisol response whereas the lower line refers to the average female cortisol response to the TSST.
Figure 2. The negative relationship between trait mindfulness and self-reported chronic stress. Males and females are shown separately and represent individual cases.
Figure 3. The negative relationship between trait mindfulness and self-reported acute stress. Males and females are shown separately and represent individual cases.
Figure 4. The gender-dependent association between trait mindfulness and cortisol stress responses. For females, mindfulness does not predict the cortisol increase. For males, high mindfulness correlates with a greater cortisol increase in response to the TSST. Shown are regression results, more specifically, findings for ±1 standard deviation of trait mindfulness scores.


