

THESIS

MINDFULNESS TRAINING AND THE MINDFULNESS-STRESS BUFFERING  
HYPOTHESIS: IMPLICATIONS FOR ADOLESCENT STRESS

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## ABSTRACT

### MINDFULNESS TRAINING AND THE MINDFULNESS-STRESS BUFFERING HYPOTHESIS: IMPLICATIONS FOR ADOLESCENT STRESS

The importance of addressing health outcomes associated with stress through managing stress is widely documented. The mindfulness-stress buffering hypothesis offers a potential solution for mitigating health outcomes associated with stress, but research examining mindfulness-stress buffering hypothesis in adolescent populations yields mixed results. To address inconsistency in the association between stress and mindfulness found in previous research, the current study examined whether participating in a mindfulness-based intervention (MBI) allowed adolescents to remain mindful under stress through examining the association between stress and mindfulness both within and between-person before, after, and during an MBI.

Between-person results indicated that, at baseline, there was a significant negative relationship between stress and mindfulness but that there was no significant association between stress and mindfulness after completion of an MBI; however, these associations were not significantly different from each other. Within-person, during the first three weeks of an MBI, there was a non-significant trend level positive relationship between mindfulness and stress; during the final three weeks, this positive association was significant. Results generally supported previous research that hypothesized that adolescents may not have the innate capacity to remain mindful when stressed, effectively using it as a buffer. Additionally, results indicated that

adolescents may display more mindfulness when stressed, compared to their average levels of stress.

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## LITERATURE REVIEW

Adolescent stress has recently been found to rival adult-level stress, with adolescents (10-25 years old, Steinberg, 2014), reporting equal or higher self-reported stress when compared to adults (American Psychological Association, 2014). Additionally, findings from the American Psychological Association (APA) suggest that unhealthy behaviors associated with stress begin in adolescence and may persist across the lifespan (2014). Further, individuals who are not coping with stress have increased mental health risks associated with their stress (Taylor et al., 1997). Compared to other critical periods across the lifespan, adolescence is a time when individuals are at increased risk for developing enduring patterns of poor mental health (Fairchild, 2011). Mental health problems that emerge in adolescence are associated with longer lasting and increasingly severe mental health problems in adulthood (Fairchild, 2011). Evidence of heightened experience of stress in adolescence, as well as possible development of unhealthy stress responses which can lead to poor mental health outcomes indicates that adolescence is a key period for stress intervention.

The mindfulness-stress buffering hypothesis suggests a potential solution to adolescent stress and the negative outcomes associated with it. The mindfulness-stress buffering hypothesis posits that mindfulness leads to reduced stress appraisals and responses, which, in turn, buffers the health impacts of stress (Creswell & Lindsay, 2014). This hypothesis suggests that if adolescents are introduced to mindfulness strategies for the purposes of stress management, they may have a dampened stress response, which could combat the negative effects that stress can have on their mental and physical health.

Current research on the mindfulness-stress buffering hypothesis within the adolescent population is inconsistent, particularly when examining differences in results when mindfulness and stress are examined between-person as opposed to within-person. Between-person or inter-individual studies of mindfulness-stress buffering provide some evidence that adolescents may have the capacity to buffer stress and health outcomes associated with stress (Ciesla et al., 2012; Marks, 2010; Lucas-Thompson et al., 2019). However, preliminary research testing the mindfulness-stress buffering hypothesis using within-person measures did not find evidence that dispositional mindfulness buffers the effects of daily stress on psychological distress in adolescents (Lucas-Thompson et al., 2021a).

Examining the association between mindfulness and stress through the lens of the mindfulness-stress buffering hypothesis using within-person, or intra-individual, measures allow for the examination of the effect of possible day-to-day variations in mindfulness and stress. This examination creates a more nuanced view of the complicated and often conflicting relationship between stress and mindfulness and perhaps, would allow one to gain more information on these contradictory results. Further, research on adolescent populations have found meaningful variations in day-to-day mindfulness (Lucas-Thompson et al., 2021a; Bluth & Eisenlohr-Moul, 2017).

The current study aims to help with the uncertainty surrounding the association between stress and mindfulness by examining whether adolescents who are taught to use mindfulness strategies (i.e., through a mindfulness-based intervention or MBI) can then remain mindful when stressed. The current study hopes to achieve this by examining the association between stress and mindfulness (Pathway a in Figure 1) using both within and between-person measures. Presented in Figure 1 is the broader conceptual model guiding this study. Although examining health

outcomes is beyond the scope of the current study, I hope that my research can lead to further studies that examine how mindfulness buffers the effect that stress can have on both mental and physical health outcomes for adolescents.

### **Adolescent Stress**

Stressful experiences in adolescence are diverse and can range from issues of identity such as a desire for independence, pressure to conform, sexual identity exploration, to more chronic stressors such as poverty or sexual abuse (Grant et al., 2003; Kessler et al., 2007). Common themes identified within adolescent stressors are issues with family, school, romantic relationships, peer relationships, future uncertainty, financial pressure, emerging adult responsibility, and tension between leisure and school activities (Bryne et al., 2007). The COVID-19 pandemic has also led to new stressors for adolescents (Wang et al., 2021)

Not only do adolescents have various stressful experiences that are unique to their age group, but there is also evidence that adolescents are particularly sensitive to stressful life events (Laceulle et al., 2015). In addition to the recent increases in stressors for adolescents (American Psychological Association, 2014), there is also evidence that the adolescent brain is highly sensitive to stress (Walker et al., 2004). The HPA axis, a neural pathway that is central to the stress response, may be heightened during adolescence, as the neural pathway continues to mature and develop (Walker et al., 2004). This increased sensitivity of the HPA axis can lead the neural pathway to be overly stress-sensitive during adolescence (Walker et al., 2004).

### **Stress and Mental Health**

For adolescents, stressful experiences can lead to negative mental health outcomes, as evidenced in pathway d in Figure 1 (Grant et al., 2003; Taylor et al., 1997). For example, stressful life events are predicative of fear temperament in adolescent populations (Laceulle et



al., 2015). Further, stressful life events such as adverse childhood experiences (ACES) experienced are also highly correlated with the onset of psychiatric disorders in adolescence (McLaughlin et al., 2012; Negriff, 2020). When individuals are exposed to chronic stress, over time, their body adapts to meet the needs that the external stress-invoking forces exert; this process is called allostasis (Taylor et al., 1997). Over time the individual's allostatic load builds leading to cumulative damage to both their physical and mental health (Taylor et al., 1997).

Compared to other critical periods across the lifespan, adolescence is a time when individuals are at increased risk for developing enduring patterns of poor mental health (Fairchild, 2011; Walker et al., 2004). Evidence also demonstrates that the longer the duration of clinical symptoms in adolescence, the worse the prognosis is for continued patterns of mental health problems in adulthood (Walker et al., 2004). A factor that can affect the observed relationship between stress and mental health in adolescents is coping strategies (Taylor et al., 1997). If individuals are taught to cope with stress in healthy ways, they have the potential to be less affected by stress. On the contrary, individuals who are not coping in a healthy way have increased mental health risks associated with their stress (Taylor et al., 1997). For example, adolescents who have behavioral problems are at higher risk for adult mental health disorders (Walker et al., 2004).

### **College Student Mental Health**

Typical college-aged individuals are around eighteen to twenty-five years of age, and are, therefore, at the end of adolescence (Steinberg, 2014). Recent findings indicate that mental health symptomology is a serious issue for college students. Thirty-two percent of college students screen positive for either depression, anxiety (Eisenberg et al., 2013). Across the past several years there have been increasing numbers of self-reported symptoms of generalized

anxiety, depression, self-harm, suicidality, and social anxiety among college students (Xiao et al., 2017). Accordingly, within the last fifteen years, there have been increases in the need for and accessing of mental health resources on college campuses (Eisenberg et al., 2013; Lipson et al., 2019; Xiao et al., 2017). For example, the rates of treatment for mental health services have increased from nineteen percent in 2007 to thirty-four percent in 2017 (Lipson et al., 2019), leading to an increasing burden of mental health services on college campuses (Eisenberg et al., 2013). This burden has recently been elevated due to a rise in mental health issues for college students during the COVID-19 pandemic (Li et al., 2021).

Stressors such as difficulty concentrating, decreased social interactions, and increased academic distress have been linked to increases in anxiety and depression symptomology in college students (Son et al., 2020). Further, seventy-one percent of college students report increases in stress due to COVID-19 (Son et al., 2020). Due to the links between stress and mental health symptomology outlined in pathway d in Figure 1, interventions that address stress within college students could ease the burden on college campuses for addressing the mental health needs of students.

## **Mindfulness**

Though there is some disagreement in mindfulness literature about how to define mindfulness, there are several themes that are consistent throughout the literature (Brown et al., 2007). Mindfulness is often cited as being comprised of present moment-oriented consciousness, stable attention and awareness, and nonjudgmental appraisal of cognitions, emotions, and bodily states (Baer et al., 2006; Brown et al., 2007; Metz et al., 2013). Combining these elements, mindfulness can be defined as nonjudgmental attention and awareness of the present moment.

Mindfulness can be viewed as a phenomenon that can be observed in the present moment (state-based) or as a trait-based characteristic (dispositional mindfulness) that is more stable across time (Brown & Ryan, 2003). The current study will be examining both trait and state-based mindfulness. State-based mindfulness is an individual's nonjudgmental attention and awareness of the present moment they are currently experiencing (Creswell & Lindsay, 2014), whereas trait-based mindfulness can be thought of as an individual's tendency to be mindful over time (Brown, Ryan, & Creswell, 2007).

Since the concept of mindfulness gained popularity in western psychological research, it has been found to be associated with various outcomes. Dispositional mindfulness has been shown to be associated with changes in affect, in that higher dispositional mindfulness is associated with increased positive emotional states and decreased negative affect (Brown & Ryan, 2003). Both dispositional and state mindfulness have also been linked with decreases in mental health symptoms such as anxiety, depression, neuroticism, and chronic pain (Barcaccia et al., 2020; Brown & Ryan, 2003; Bellinger et al., 2015).

### **Mindfulness and Stress**

Mindfulness is a commonly researched protective factor for both adolescent and adult mental health outcomes (Barcaccia et al., 2020; Muris & Petrocchi, 2017) and is associated with an increase in positive stress responses in adolescence (Lucas-Thompson et al., 2019). There are several pathways through which mindfulness and stress are associated, as expressed in Figure 1. The association between mindfulness and stress is bidirectional wherein stressful experiences can make it hard to remain mindful (pathway a in Figure 1) and also mindfulness can promote stress processing behaviors, like coping, and lead to reduced appraisals of stress (pathway b in Figure 1).

Both dispositional and state mindfulness have consistently been associated with decreases in stress, as shown in pathway b in Figure 1 (Barcaccia et al., 2020; Bellinger et al., 2015; Brown & Ryan, 2003). Mindfulness is posited, within the mindfulness-stress buffering hypothesis, to be associated with more positive appraisals of stressful events which leads to a reduction in perceived stress (Creswell & Lindsay, 2014). The nonjudgmental evaluation of the present moment, that occurs in a mindful state, is hypothesized to lead to a reduction in emotional reactivity and a further acceptance of undesirable states, which leads to an increase in regulation during stressful events (Brown et al., 2007). This increased regulatory capacity is a pathway through which mindfulness can reduce stress appraisals (Brown et al., 2007). Additionally, insight into one's thoughts gained through mindfulness practice may lead to increase in awareness of damaging and unrealistic thought patterns, leading individuals to halt negative thinking, which, in turn, leads to a decrease in an individual's appraisal of stress in their life, reducing their stress response (Brown et al., 2007).

However, a lack of neurobiological development in adolescence may prevent adolescents from utilizing mindfulness as effectively or efficiently as adults do when combatting stress. Research indicates that the neurobiological capacity to be mindful may still developing in adolescence (Kesek et al., 2009; Marks et al., 2010), indicating that some adolescents may have difficulty using mindfulness to cope with stress due to lack of neurobiological development.

The current study will instead examine the unique impact that stress has on mindfulness (pathway a in Figure 1). Examining the effect that stress has on mindfulness can increase understanding as to how adolescent's stress levels affect their ability to remain mindful. Recent findings with adolescents demonstrate that adolescents who report more stressful experiences compared to their average level, reported significantly lower levels of mindfulness compared to

their average mindfulness (Lucas-Thompson et al., 2021a). This demonstrates how increases in stressful life events can lead to reductions in mindfulness for adolescents who haven't received instruction in how to remain mindful during stress.

### **Mindfulness Interventions**

Mindful attention is something that can be increased through targeted intervention, such as a mindfulness training (pathway e in Figure 1; Carmody & Baer, 2008; Germer et al., 2005; Visted et al., 2014). Mindfulness interventions are interventions targeted at helping individuals become more mindful and therefore access the benefits of living mindfully. Mindfulness interventions increase self-reported mindfulness and, accordingly, lead to positive, mindfulness-based, outcomes (Visted et al., 2014). For example, mindfulness trainings are associated with decreases in stress, anxiety, and increases in emotional regulation (Carmody & Baer, 2008; Odgers et al., 2020; Metz et al., 2013).

Many mindfulness interventions, called Mindfulness-Based Stress Reduction (MBSR) programs, are specifically targeted at stress reduction (Carmody & Baer, 2008). MBSRs are effective at increasing mindfulness and wellbeing as well as decreasing stress symptomology (Carmody & Baer, 2008). Mindfulness-based interventions, or MBIs, are more generally focused on increasing mindfulness, without the specific target of decreasing stress (Odgers et al., 2020); although, MBIs may still have specific content that is aimed at remaining mindful when stressed or upset (Broderick, 2013). MBIs have demonstrated positive effects on not only stress, but also mental health symptoms (pathway e & c in Figure 1; Brown et al., 2007; Odgers et al., 2020). For example, MBIs lead to a reduction in anxiety by reducing anxious thought patterns (Odgers et al., 2020). MBIs can help individuals achieve this through increasing non-judgmental present moment awareness (pathway e), which can lead to depersonalization of anxiety symptomology

and allow individuals to see their thoughts as just thoughts (pathway c; Brown et al., 2007). Because MBIs can affect both stress and mental health symptomology, they can make an impact on both factors that are elevated for college aged adolescents.

### **Learning to BREATHE**

Learning to BREATHE (L2B) is a six-week MBI that was established using MBSR program's concepts and was designed to be developmentally appropriate for adolescents (Broderick, 2013). The program is structured around six themes that spell out BREATHE: body, reflection, emotions, attention, tenderness, and healthy habits of mind, building to an overall goal of empowerment (Broderick, 2013). Each of the six themes are built around teaching participants mindfulness skills with the goal of building emotion regulation, reducing stress, remaining mindful under stress, improving school performance, and building attention in the classroom (Broderick, 2013).

Mindfulness techniques taught in L2B help adolescents respond more mindfully to stressors by teaching adolescents to regulate when experiencing stress. This is demonstrated through the program's association with outcomes such as increases in emotion regulation, coping, and, more specifically, stress management (Metz et al., 2013; Eva & Thayer, 2017). Further, the fourth week of L2B, A or attention, focuses specifically on stress and mindfulness (Broderick, 2013).

L2B has also been associated with other positive outcomes, such as, increases in self-esteem, emotional clarity, time management, organization, and relationship functioning (Eva & Thayer, 2017; Mahfouz et al., 2018; Metz et al., 2013). Participation in L2B has also been associated with positive health outcomes for college students, such as improvements in psychological health (Mahfouz et al., 2018; Tang et al., 2021).

## **Mindfulness-Stress Buffering Hypothesis**

The mindfulness-stress buffering hypothesis proposes a pathway through which mindfulness promotes health (Creswell & Lindsay, 2014). In accordance with the mindfulness-stress buffering hypothesis, an individual who is mindful can have reduced stress appraisals, when compared to those who are not mindful (pathway b in Figure 1; Creswell & Lindsay, 2014). The hypothesis indicates that mindfulness moderates, or buffers, the relationship between stressors and health, as described in pathway c in Figure 1. The buffering occurs because the mindful individual's increasingly positive cognitive appraisals of the experienced stress reduce their physiological stress reactivity (Creswell & Lindsay, 2014). Physiological stress reactivity is what links stress with negative health outcomes (Taylor et al., 1997). Their reduced stress appraisals are what mitigates their stress response and buffers the effects that stress has on their health (Creswell & Lindsay, 2014).

To have these reduced stress appraisals, when experiencing stress, the individual must be able to have consistent levels of mindfulness when stressed, which allow them to continuously buffer stress outcomes by remaining mindful. The mindfulness-stress buffering hypothesis further hypothesizes that the impact that mindfulness has on health should be most easily observed with individuals experiencing high stress because individuals with high stress are more likely to have observable stress-linked health outcomes that are being buffered by mindfulness (Creswell & Lindsay, 2014).

Between-person or inter-individual studies of mindfulness-stress buffering provide some evidence that adolescents may have the capacity to buffer health outcomes associated with stress (Ciesla et al., 2012; Marks, 2010; Lucas-Thompson et al., 2019). For example, Ciesla and colleagues found evidence that trait levels of mindfulness buffer the effects that daily reported

stress have on daily sadness (2012). This provides evidence that mindfulness can buffer the effects that day-to-day variations of stress have on health outcomes for adolescents. Other between-person measures have found evidence for similar buffering effects. Marks and colleagues (2010) found evidence that dispositional mindfulness decreased the strength of the relationship between the frequency of life hassles and stress, as well as symptoms related to depression and anxiety for adolescents. This provides similar evidence that dispositional mindfulness can buffer mental health outcomes that are often linked with stress (i.e., depression and anxiety). However, other between-person studies have found mixed evidence for the effect that dispositional mindfulness has on other stress related health outcomes.

Lucas-Thompson and colleagues (2019) demonstrated that higher dispositional mindfulness was associated with reduced emotional and cardiovascular responding to a social stress test, indicating that mindfulness may improve adolescent's response to stress. This finding is in-line with the reduced physiological stress reactivity aspect of the mindfulness-stress buffering hypothesis (Creswell & Lindsay, 2014). However, the study also found that higher dispositional mindfulness was associated with increased cortisol reactivity in response to the social stress test (Lucas-Thompson et al., 2019). This particular finding was especially prevalent for adolescents reporting low perceived life stress (Lucas-Thompson et al., 2019). Although this finding indicates heightened physiological stress reactivity for those with high dispositional mindfulness, Creswell and Lindsay did indicate that the impact of mindfulness on health would be most easily observed on populations with high stress in their daily lives (2014).

Within-person measures of mindfulness, or studies that examine variations in mindfulness within the individual, allow for researchers to examine how/if individual variations of mindfulness and stress affect mindfulness-stress buffering. Within-person studies are essential



when examining the mindfulness-stress buffering hypothesis for a few reasons. First, reported levels of mindfulness have been shown to vary day-to-day for adult populations through research examining within-person differences in mindfulness (Eisenlohr-Moul et al., 2016; Hulsheger et al., 2013; Shiyko et al., 2016). These findings within adult populations have also been demonstrated in preliminary research on adolescent populations (Lucas-Thompson et al., 2021a; Bluth & Eisenlohr-Moul, 2017), with daily stress predicting reduced daily mindfulness (Lucas-Thompson et al., 2021a). This demonstrates the importance of examining state-based mindfulness, within-subjects, to observe the influence that day-to-day variations in mindfulness could have on a participant. This variation in day-to-day mindfulness may indicate that it is more difficult for adolescents to remain mindful on days where they are experiencing higher levels of stress, so examining day-to-day variations in stress and mindfulness could help us better understand the association between stress and mindfulness. Second, effects that are found between-people may not be replicable when examining the same phenomena within-people, indicating that it is necessary to examine associations both within-person and between-people (Chen et al., 2005).

### **Current Study**

Although mindfulness and mindfulness-based interventions are linked to reductions in stress (Lucas-Thompson et al., 2020; Metz et al., 2013; Eva & Thayer, 2017), mixed findings in the literature suggests that mindfulness-stress buffering is complicated when testing the theory in adolescent populations. The question that one is left with after reviewing the literature is: Can adolescents learn to remain mindful under when they are under stress after participating in an MBI? A lack of pure capacity to remain mindful when stressed, as indicated in preliminary within-person research (Lucas-Thompson et al., 2021a), may indicate the need for mindfulness

to be taught as a tool against stress for adolescent populations. Mindfulness-based interventions have been shown to increase a person's mindfulness (Visted et al., 2014). If adolescents' dispositional mindfulness is increased through an MBI, they may then be able to sustain a state of mindfulness when stressed, and therefore use it as a buffer against stress, as indicated in the mindfulness-stress buffering hypothesis. Day-to-day assessments of state mindfulness and stress may yield some clarity as to how variations in mindfulness and stress affect each other. This will also clarify if adolescents are more consistently mindful as they participate in an MBI and learn skills that specifically discuss using mindfulness, when experiencing stress, as taught in the fourth week of L2B (Broderick, 2013).

The current study aims to examine whether adolescents can remain consistently mindful when stressed before, during, and after participating in an MBI, L2B. This study will be the first to examine whether participating in an MBI allows adolescents to remain mindful under stress. Although this project does not directly examine health outcomes, if the findings are in-line with the mindfulness-stress buffering hypothesis, results would indicate that adolescents may be able to effectively use mindfulness as a buffer against health outcomes related to stress.

My first set of hypothesizes considers between-person measures of mindfulness and stress. I hypothesized that, before participating in an MBI, there was a negative relationship between mindfulness and stress, or that people who reported more stress also reported less mindfulness. I expected that, after participating in L2B, there was no significant relationship between mindfulness and stress because adolescents should be able to remain consistently mindful when stressed, indicating that stress reported does not reduce mindfulness reported.

My second set of hypothesizes considers within-person measures of mindfulness and stress. I hypothesized that, during the first three weeks of L2B training, before learning about

remaining mindful under stress, within-person measures would show a negative relationship between mindfulness and stress, such that on days that the adolescents experienced more stress, relative to their average stress levels, they reported less mindfulness, relative to their own typical mindfulness. The fourth week of L2B training, “A” or attention, focuses on mindfulness and stress (Broderick, 2013), so I hypothesized that, in the final three weeks, participants were able to remain mindful when stressed by utilizing tools learned in the fourth week. Due to this, I hypothesized that, during the last three weeks of mindfulness training, on days that the adolescents reported stress levels outside of their average stress scores, they reported levels of mindfulness that are consistent with their typical mindfulness scores (i.e., no significant association between stress and mindfulness).

## METHODS

### Participants

Twenty-seven adolescents ( $M_{age} = 19.48$ ,  $SD = 2.56$ ) from a large western university participated in the study. Inclusion criteria for the study were evaluated using an online screener. Potential participants had to respond as to how often they feel stressed or anxious using a Likert scale from 1 (“never”) to 6 (“very frequently”). Participants had to report at least 4 (“occasionally”) feeling anxious or stressed and report they have access to an SMS-capable phone to be considered eligible for the study. Participants who were not considered eligible for the larger study were informed via email. In addition, participants will be excluded from this secondary data analysis if they are over twenty-five years old.

Participants were recruited from undergraduate human development and family studies classes or mental health service providers at a large western University. Undergraduate classes in human development and family studies displayed a flyer on their online course page either as an announcement or individual post. Individuals interested about the study were then prompted in the virtual flyer to reach out via email and express interest in the study.

Individuals on the client waitlist seeking psychological services at the college were also recruited. They were first informed they may be contacted about the study when being added to the waitlist. Graduate research assistants then contacted the waitlisted clients and explained the study, emphasizing it is not a replacement for mental health services, and followed up with interested individuals via email, which included the survey screener. Both methods of outreach explained that participants would be participating in a study that involved a 6-week mindfulness training, Learning to BREATHE (L2B; Broderick, 2013).

Participants were mostly non-Hispanic Caucasian (81.5%) and the only other ethnicity reported was Hispanic or Latino (14.8%) with one person not reporting ethnicity (3.7%).

Participants came from households with family incomes that ranged from less than or equal to \$35,000 to \$150,000 and on average ranged from \$65,000 to \$94,000. Participant's parents or caregivers' education levels ranged from high school diplomas to a four-year college or bachelor's degree and on average ranged from some college to an associate degree or two-year college degree.

## **Procedure**

Procedures were part of a larger study that was targeted at understanding what added benefits L2B Plus has on college aged students experiencing stress or anxiety when compared with L2B. L2B Plus contains components that are not in the traditional L2B curriculum such as an on-demand web library, text messaging, and ecological momentary interventions (EMI) that were sent in accordance with responses participants had to the ecological momentary assessments (EMA) (Lucas-Thompson et al., 2020).

All procedures for the larger study were approved by the Institutional Review Board; only the parts of the study that are relevant to this project will be described in this paper. After being accepted into the study, participants completed a baseline, or pre-test survey. Participants provided informed consent before completing the baseline survey. The pre-test survey gathered information on state and trait-based mindfulness and stress. The survey took participants around 15 minutes and was required to be completed before participants can begin the L2B curriculum.

L2B curriculum was given online via Microsoft Teams once a week over the course of six weeks. Each of the classes were structured around seven themes that spell out BREATHE: body, reflection, emotions, attention, tenderness, healthy habits of mind, and empowerment

(Broderick, 2013). Every class focused on one of the seven themes; however, empowerment is interwoven into each of the six classes and does not have a standalone class to teach the concepts. Each of the six classes were structured around teaching adolescents' mindfulness skills that are specific to the theme. For example, "R" or reflection class did this through including activities that focused on how powerful thoughts can be as well as the power of letting thoughts come and go without judgement (Broderick, 2013).

Throughout the course of the L2B curriculum, participants simultaneously received nightly EMAs prompting them to complete a survey, or daily diary, that assessed mindfulness, stress, emotions, sleep, and substance use. The daily diary is a short survey that was estimated to take less than five minutes a day. After the six weeks of L2B are completed, participants then completed a post-test survey that included the same measures as the pre-test survey.

## **Measures**

**Pre and Post L2B Mindfulness.** To assess dispositional mindfulness of participants before and after the mindfulness training, L2B, participants followed the protocol outlined by Brown and Colleagues (2011) in the Mindful Attention Awareness Scale-adolescent version (MAAS-A). The participants rated the level at which they tend to act mindlessly by responding to statements like "I rush through activities without being really attentive to them" through a Likert scale from 1 ('not at all') to 6 ('very much'). Higher means scores on the MAAS-A indicate lower mindfulness ( $\alpha = 0.85$  at pre-test,  $\alpha = 0.86$  at post-test).

**Pre and Post L2B Plus Stress.** To assess the level of stress that participants were experiencing before and after L2B Plus, participants responded to the Perceived Stress Scale (PSS; Cohen et al., 1983). The PSS is a fourteen-item questionnaire that asks participants to respond to questions like "In the last month, how often have you been upset because of

something that happened unexpectedly.” Participants respond on a Likert scale from 0 (‘never’) to 4 (‘very often’). Higher mean scores on the PSS are reflective of higher levels of perceived stress ( $\alpha = 0.83$  at pre-test,  $\alpha = 0.78$  at post-test).

**Daily Mindfulness.** Participants responded to the Mindful Attention Awareness Scale, State Version to assess daily mindfulness on their daily diary questionnaire throughout the course of L2B (Brown & Ryan, 2003). Participants rated the degree with which they were currently experiencing each statement (e.g., “I was doing something without paying attention”) on a scale from 1 (‘not at all’) to 6 (‘very much’). Higher mean scores are indicative of lower state mindfulness.

**Daily Stress.** To measure the stress that participants were experiencing daily while completing L2B, participants responded to the state version of the PSS (Cohen et al., 1983). The PSS is a four-item questionnaire that asks participants to respond to questions like “today I felt unable to control the important things in my life.” Participants respond on a Likert scale from 1 (‘never’) to 5 (‘very often’). Higher scores on the PSS are reflective of higher levels of perceived stress.

## DATA ANALYSIS

The purpose of the current study is not to understand the extent to which the mindfulness practices library or other aspects of the L2B Plus conditions effected mindfulness and stress, but to examine the associations between stress and mindfulness more broadly. To look broadly at stress and mindfulness, the data analysis combined all conditions in the larger study, as all participants experienced the MBI, L2B. To examine whether the association between mindfulness and stress is altered by mindfulness training in L2B, I examined both within-person and between-person hypotheses to parse apart the differences in the associations both across adolescents and differences from mean levels, by person.

First, to examine the between-person association between mindfulness and stress in both the pre and post-test measures, I completed two regressions aimed at predicting mindfulness from stress and demographic measures (i.e., age, race, family income, and ethnicity). The first regression used pre-test measurements of dispositional mindfulness and stress to examine the first hypothesis, that people who reported more stress also reported less mindfulness, before participating in an MBI. The regression predicted mindfulness from stress as well as demographic measures mentioned above. The second regression used post-test measurements of stress and dispositional mindfulness to examine the association between them after completion of L2B, while controlling for baseline dispositional mindfulness and demographic variables. The regression controlled for dispositional mindfulness at onset to protect against spurious associations that could be due to a participant entering the study with high mindfulness when compared to the average population.



To examine if the relationship between stress and mindfulness at baseline is significantly different than the relationship between stress and mindfulness posttest, semi-partial correlations between stress and mindfulness at pre and post-test were compared. The semi-partial correlations were compared using a statistical calculator that measures the significance of the difference between two correlations based on sample size and correlation coefficients.

Second, to examine the within-person association between mindfulness and stress at the first three weeks versus the last three weeks of L2B, I used two multi-level models. Multi-level models were conducted in Stata 15 to examine between-person and within-person associations between stress and mindfulness. Both between and within variables were calculated and included in the model; between-person variables represented average levels of stress by person while within-person variables represented deviations from each person's mean level of stress, by day.

The first multilevel model focused on the first three weeks of L2B, and examined the association between mindfulness and stress, within-person. The second multi-level model focused the second half, or last three weeks, of L2B. This separation between the first and last three weeks is due to week four's L2B topic "A" or attention, where the program focuses on how to use mindfulness when stressed. The final multi-level model examined the association between mindfulness and stress, within-person for the last three weeks of L2B.

## RESULTS

Preliminary correlations and descriptive statistics, described in table 1, indicate that baseline stress is significantly negatively correlated with baseline mindfulness such that higher scores of stresses were associated with lower scores of mindfulness at baseline. There were no other significant correlations found between any other variables included in table 1.

### **Between-Person Association Between Stress and Mindfulness**

Statistical tests, run in SPSS, demonstrated that, when controlling for race, age, parental income, and parental education, there was a significant negative association between stress and mindfulness in baseline measures, such that as stress increased, mindfulness decreased; this association was medium in size (Table 2). The significant association between stress and mindfulness during the post-test measures (Table 3) was non-significant and small in size. However, there was no significant difference between these two semi-partial correlations,  $z = -0.91, p = 0.36$ .

### **Within-Person Associations between Stress and Mindfulness**

The first three weeks of L2B Plus had 30 participants and 307 total observations, with an average of 10.2 observations per participant. Multilevel models run in Stata 15 demonstrated that, in the first three weeks of L2B Plus, the association between stress and mindfulness was not significant, but there was a trend-level positive association between stress and mindfulness (i.e., when participants reported higher stress scores compared to their average, they reported higher mindfulness scores compared to their average mindfulness scores and this association was small in size; Table 4). The last three weeks of L2B Plus had 28 participants with 384 total observations and an average of 13.7 observations per participant. In the last three weeks of L2B

Plus, there was a significant and positive relationship between stress and mindfulness, such that when participants were experiencing higher levels of stress, compared to their average stress score, they reported higher mindfulness, compared to their average mindfulness score and this association was small in size (Table 5).

## DISCUSSION

The goal of the current study was to be the first to examine whether participating in an MBI allows adolescents to remain mindful under stress through examining the association between stress and mindfulness both within and between-person before, after, and during an MBI. Between-person results indicated that, at baseline, there was a significant negative relationship between stress and mindfulness but that there was no significant association between stress and mindfulness after completion of L2B; however, these associations were not significantly different from each other. Within-person, during the first three weeks of L2B, there was a non-significant trend level positive relationship between mindfulness and stress; during the final three weeks, this positive association was significant.

Recent research examining the mindfulness-stress buffering hypothesis within-person found that as adolescents experienced more stress, they reported less mindfulness (Lucas-Thompson et al., 2021a). The current study also found a significant negative association between stress and mindfulness in the baseline measures, confirming that, before intervention, adolescent's mindfulness scores decreased as their stress scores increased. For mindfulness to moderate the association between health outcomes and stress, as indicated in the mindfulness-stress buffering hypothesis, the individual must be able to have consistent levels of mindfulness when stressed (Creswell & Lindsay, 2014). Consistent levels of mindfulness or mindfulness levels that are not significantly affected by stress, allow them to continuously buffer stress outcomes by remaining mindful. These findings suggest that adolescents may not possess the innate ability to effectively use mindfulness as a buffer, in line with past research. Also, in line with the current study's hypotheses, the current study did not find a significant association

between stress and mindfulness in the post-test measures. This finding could indicate that adolescent mindfulness is less impacted by their stress after participating in an MBI. Further, this provides evidence that adolescents may be able to maintain consistent levels of mindfulness when stress after an MBI, which is an integral aspect of the mindfulness-stress buffering hypothesis (Creswell & Lindsay, 2014). Findings that are in-line with the mindfulness-stress buffering hypothesis further indicate that adolescents may be able to use mindfulness to buffer the health impacts of stress.

However, a comparison of semi-partial correlations demonstrated that the post-test correlations were not significantly different than the pre-test correlations. This lack of difference could be due to a lack of power (because of a relatively small sample) or could indicate that mindfulness training does not significantly affect the association between stress and mindfulness. Research indicates that participation in mindfulness training increases mindfulness (Carmody & Baer, 2008; Germer et al., 2005; Visted et al., 2014) and decreases stress (Carmody & Baer, 2008; Odgers et al., 2020; Metz et al., 2013) but is there no current research that examines the association between stress and mindfulness before and after L2B. Future research should examine if the association between stress and mindfulness is significantly different after mindfulness training to further examine this associations in other contexts.

Turning to the within-person analyses, examinations of mindfulness and stress within-person during the first three weeks of L2B Plus, while not significant, demonstrated a trend-level positive association between stress and mindfulness. The trend-level positive associations demonstrated that, when participants reported higher stress scores compared to their average, they reported higher mindfulness scores compared to their average mindfulness scores during the first three weeks of L2B. This is in conflict with previous within-person research that indicated

that, as participants experienced higher than average stress, they reported lower than average mindfulness (Lucas-Thompson et al., 2021a). It, instead, may indicate that participants were beginning to actively increase their use of mindfulness to cope with the increases in stress they were experiencing. This finding also may indicate that adolescents may not need to be taught specifically how to use mindfulness when stressed, and they may be able to implore mindfulness strategies when stressed before specifically being taught how to do so.

However, participants in the current study are near the end of adolescence ( $M_{age} = 19.48$ ), which is defined by Steinberg as 10-25 years old (2014). Therefore, the sample in the current study may not be developmentally representative of the average adolescent due to older age and possibly more progressed neurobiological development. Research indicates that the neurobiological capacity to be mindful may still be developing in adolescence (Kesek et al., 2009; Marks et al., 2010), indicating that some adolescents may have difficulty using mindfulness to cope with stress, due to lack of neurobiological development. Previous research additionally provides evidence that adolescents may not have the capacity to remain mindful when stressed (Lucas-Thompson et al., 2021a). This study indicates that adolescents of this particular age and background do, indeed, have the capacity to remain mindful when stressed. However, further research should examine whether individuals who are younger adolescents have similar results with use of an MBI to examine the unique affect age could have in the current study.

During the last three weeks of L2B, there was a significant positive relationship between stress and mindfulness, such that, as participants were experiencing higher levels of stress, compared to their average scores, they were also experiencing higher levels of mindfulness, compared to their average scores. The findings during the last three weeks of L2B may indicate that participants were actively increasing their use of mindfulness to cope with stress they were

experiencing. The findings may also indicate that either the amount of time in a mindfulness training, or the specific content taught in the fourth week that teaches participants how to use mindfulness when experiencing stress, may have an impact on the significance of the relationship between stress and mindfulness within-person. Future research should examine if learning specific mindfulness strategies to use when stressed earlier in L2B affects this relationship.

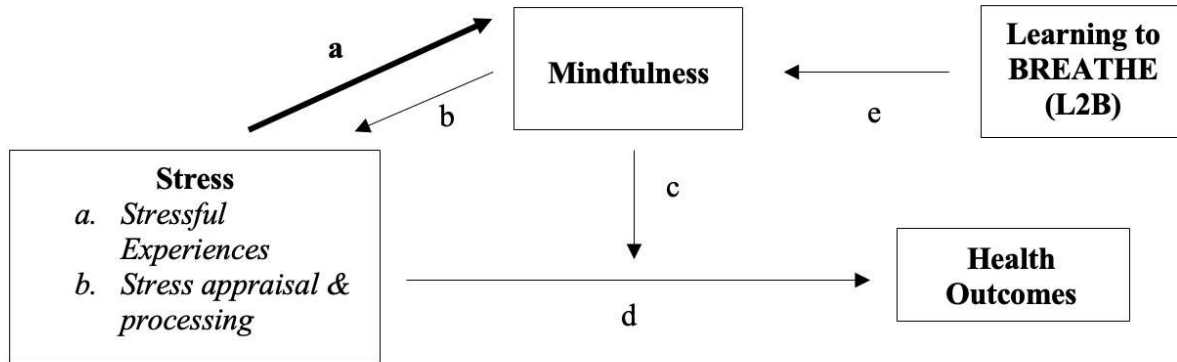
Both within-person findings align, in part, with the mindfulness-stress buffering hypothesis because they are indicative that adolescents are mindful when stressed. While they may not be “consistently” mindful, which would be demonstrated by finding no significant relationship between mindfulness and stress, they are utilizing mindfulness when stressed (Creswell & Lindsay, 2014). Future research should examine if an increase in mindfulness when stressed, as opposed to a consistent level of mindfulness when experiencing stress, buffers the impact that stress has on mental health.

Another consideration that could have led to these outcomes, which are not in-line with previous research for adolescents (Lucas-Thompson et al., 2021a), is a limitation that this study has, which is that this sample is different than the average adolescent in several ways. By utilizing a sample of college students, the participants in this sample have all experienced some higher education, which may not be representative of the average adolescent. However, recent research argues that college students increasingly represent the U.S. population (Lederer & Oswalt, 2017). Further, this sample is a majority non-Hispanic Caucasian (81.5%). Future research should examine whether these results can be replicated with a sample that is more representative of the average adolescent.

The current study provides several clinical implications. The first is that MBIs may aid adolescents in being mindful when stressed. Because findings align with the mindfulness-stress buffering hypothesis, these findings could indicate that adolescents who are experiencing health outcomes associated with stress, could buffer these outcomes after participating in an MBI. The second is that MBIs could also be used as a tool on college campuses to reduce mental health outcomes associated with stress. College students struggle with various health outcomes and are known to have high rates of mental health concerns (Lederer & Oswalt., 2017). This research provides preliminary evidence that MBIs could aid in alleviating the burden that high rates of mental health concerns among college students have on campus mental health resources, due to the findings alignment with the Mindfulness-Stress buffering hypothesis. Research indicates that college campuses are uniquely situated for promoting health and addressing health issues (Lederer & Oswalt., 2017), this research presents an opportunity for college campuses to lean into the benefits that MBIs can yield.



## TABLES AND FIGURES



**Figure 1**

*Mindfulness, Stress, Health, and Learning to BREATHE Conceptual Model*

*Note.* This figure provides a visual aid for all pathways discussed throughout this literature review.

**Table 1**

*Bivariate Correlations and Descriptive Statistics*

Variable	1.	2.	3.	4.	5.	6.	7.	8.
1. Baseline Stress	-							
2. Posttest Stress	0.36	-						
3. Baseline Mindfulness	-	-0.25	-					
4. Posttest Mindfulness	0.51***	0.09	-0.36	0.13	-			
5. Age	-0.08	-0.23	-0.15	0.37	-			
6. Race <sup>a</sup>	-0.14	-0.28	0.19	0.33	0.01	-		
7. Family Income	-0.21	0.01	0.26	-0.24	-0.07	0.17	-	
8. Parental Education Level	-0.04	0.05	0.48	0.13	0.15	0.19	-0.08	-
<i>M</i>	2.58	2.23	3.19	3.93	20.02	0.79	4.11 <sup>b</sup>	4.04 <sup>c</sup>
<i>SD</i>	0.48	0.48	0.75	0.71	2.03	0.41	2.88	0.79

\*  $p < .05$  \*\*\*  $p < .001$  <sup>a</sup>1 = white, 0 = other <sup>b</sup>4 = \$65,000 - \$79,000 <sup>c</sup>4 = some college, no degree, 5 = 2-year college or associates degree

**Table 2***Regression Predicting Baseline Mindfulness from Baseline Stress*

Variable	<i>b</i>	<i>SE</i>	$\beta$	<i>t</i>	<i>p</i>
Baseline Stress	-0.63	0.28	-0.43	-2.23	0.04
Age	-0.05	0.05	-0.17	-1.04	0.31
Race <sup>a</sup>	0.25	0.36	0.13	0.68	0.51
Income	0.06	0.04	0.29	1.47	0.16
Education Level	0.12	0.20	0.12	0.62	0.55

*R*<sup>2</sup> = .50 <sup>a</sup>1 = white, 0 = other**Table 3***Regression Predicting Post-Test Mindfulness from Post-Test Stress*

Variable	<i>B</i>	<i>SE</i>	$\beta$	<i>t</i>	<i>p</i>
Posttest Stress	-0.21	0.33	-0.15	-0.63	0.54
Baseline Mindfulness	0.20	0.26	0.20	0.80	0.44
Age	0.10	0.06	0.37	1.73	0.10
Race <sup>a</sup>	0.55	0.46	0.28	1.20	0.25
Income	-0.09	0.06	-0.38	-1.55	0.14
Education Level	-0.11	0.25	-0.11	-0.46	0.65

*R*<sup>2</sup> = .40 <sup>a</sup>1 = white, 0 = other**Table 4***Multilevel Modeling of Daily Stressors in relation to Mindfulness- Weeks 1-3*

Parameter	With Random Slopes				
	<i>Est.</i>	<i>SE</i>	<i>App.</i> $\beta$	<i>p</i>	95% CI
Average Stress BS <sup>a</sup>	-.01	.02	-.05	.69	-.04, .03
Deviations from Average Stress WS <sup>b</sup>	.02	.01	.10	.06	-.00, .04
Intercept	3.96	.35	-	< .001	3.28, 4.64

<sup>a</sup>BS indicates between-subjects; <sup>b</sup>WS indices within-subjects <sup>c</sup>Raw variable was standardized to approximate a  $\beta$

**Table 5***Multilevel Modeling of Daily Stressors in relation to Mindfulness- Weeks 4-6*

With Random Slopes
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Parameter	<i>Est.</i>	<i>SE</i>	<i>App.</i> <i><math>\beta</math></i>	<i>p</i>	95% CI
Average Stress BS <sup>a</sup>	-.01	.02	-.09	.61	-.06, .03
Deviations from Average Stress WS <sup>b</sup>	.04	.01	.13	< .001	.02, .06
Intercept	4.40	.46	-	< .001	3.49, 5.31

<sup>a</sup>BS indicates between-subjects; <sup>b</sup>WS indices within-subjects <sup>c</sup>Raw variable was standardized to approximate a  $\beta$

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