EXPLORING THE EFFECTIVENESS OF A MINDFULNESS TRAINING APP FOR MANAGING STRESS IN A UNIVERSITY STUDENT POPULATION: A PILOT STUDY

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ABSTRACT

The goal of this pilot study was to test the effectiveness of a 4-week self-help protocol using a mindfulness training application delivered via smartphone for managing stress in a university student population. The study sample included 21 university undergraduate and graduate students (11 in the intervention group; 10 in the control group) whose ages ranged from 18-25 years of age (M=20.89, SD=2.18). Participants were assessed on pre- and post-intervention measures of mindfulness, using the Cognitive and Affective Mindfulness Scale–Revised (CAMS-R; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007); psychological stress, measured by the Perceived Stress Scale (PSS-10; Cohen, Kamarck, & Mermelstein, 1983); physiological stress measured by Heart Rate Variability; stereotype threat (gender stigma consciousness and ethnicity stigma consciousness) measured by the Social Identities and Attitudes Scale (SIAS; Picho & Brown, 2011); and coping style, measured by the Brief COPE (Brief COPE; Carver, 1997).

Results of the study indicated that there was a significant difference in physiological stress scores [F(1,18)=5.597, p=.029] between the two groups, with a large effect size (partial eta squared was .237). The students who utilized the mindfulness training app had a larger overall decrease in physiological stress scores (i.e., increase in HRV), than did the control group, with the intervention group’s post-test HRV scores increasing 2.91%, while the control group’s post-test HRV scores decreased 6.01% from their pre-test HRV scores. Although not statistically significant, the intervention group exhibited a higher overall increase in mindfulness, decrease in psychological stress, decrease in stereotype threat (gender stigma consciousness and ethnicity stigma consciousness), and lower levels of maladaptive coping (denial and behavioral disengagement) than the control group.
Finally, the mindfulness training app appeared to be relatively easy to use and effective for managing stress, as 90.9% of the students using the mindfulness training app rated the tasks required by the intervention as being either easy or very easy; 90.9% endorsed either agreeing or strongly agreeing that they found the intervention useful; and 81.8% endorsed either agreeing or strongly agreeing that they would suggest this type of practice for stress management.
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Chapter 1: Introduction

Stress is ubiquitous in American society. A recent survey conducted by the Harvard School of Public Health (NPR/RWJ Foundation, 2014) indicated that nearly half (49 percent) of Americans reported having a “major stressful event or experience” in the past year, and more than a quarter (26 percent) reported a “great deal of stress” within the past month. In addition to a high prevalence rate, stress appears to be on the rise in American society. Cohen and Janicki-Deverts (2012) found that over a 26-year period, ranging from 1983-2009, there was a 10-30 percent increase in stress across all demographic categories, including an 18 percent increase for women and a 24 percent increase for men.

Statement of the problem

While stress may be on the rise across all demographic categories, one group that may be in high need of more evidence-based methods for managing stress is university students. A study by Dixon and Robinson Kurpious (2008) found that the majority of university students reported feeling “moderate” or “serious stress.” These findings are concordant with previous studies that found that younger people tend to have higher levels of perceived stress than their older adult counterparts (Hamarat et al., 2001). According to Arnett (2000, 2005, 2007), university students may be particularly at risk due to the stressors associated with this developmental stage, including an increased risk for substance use, risky driving behaviors, and unprotected sex. In addition to the potential for high risk behaviors, chronic stress can have a variety of negative health consequences. It has been found that high levels of chronic stress are associated with various forms of mental distress such as anxiety and depression (Hammen, 2005), and can impact students’ ability to successfully adjust across academic, social, personal/emotional, and institutional domains (Baker & Siryk, 1984).
Stress in university students may be a particularly salient issue in the US, as growing enrollment has led to an increase in the total number of students attending college over the last decade. According to the United States Department of Education (2012), between 2000 and 2010 university enrollment increased 37 percent, from 15.3 million to 21.0 million students registered annually. Of particular concern is the fact that while recent research has revealed increasing rates of anxiety and depression among university students, only a small percentage of these students receive treatment from university health services (Regehr, Glancy, & Pitts, 2013).

This current college cohort, “the Millennial generation,” may pose unique characteristics compared to their previous cohort; and these characteristics can greatly impact both the types of stress these students face, as well as how they handle stress (Elam, Stratton, & Gibson, 2007). For example, at a 39% minority rate, the Millennial generation is more ethnically diverse than either the Baby Boomer Generation or Generation X (Weston, 2006); and has a greater percentage of females than previous generations (US Dept. of Education, 2012). Along with greater ethnic and gender diversity, there comes the concern that a greater number of college students could experience specific stressors, including that of greater stereotype threat susceptibility. *Stereotype threat (ST)* is defined as the pressure resulting from social comparisons that are perceived as unfavourable (Weger et al., 2012). Studies have found that individuals who experience stereotype threat show performance decrements across a wide range of tasks (Steele, 1997; Weger et al., 2012) which can have impacts on a variety of social, emotional, and academic areas.

Therefore, it seems that Millennial generation university students may represent a unique population that is susceptible to the deleterious impacts of stress, but paradoxically, may not be utilizing interventions that could help them to protect against this stress. In addition to finding
ways to make traditional university health services more accessible, it may be necessary to
develop and evaluate alternative approaches, including health-focused preventative programs
and self-help interventions, which may help to reduce students’ stress and improve their ability
to successfully adjust across a variety of socio-emotional and academic-related domains.

Brief literature review

Finding effective ways to cope with and manage stress is essential. Psychological stress
is defined as when a person believes that environmental demands exceed his or her adaptive
capacity (Cohen, Janicki-Deverts, & Miller, 2007). It is thought that the way individuals
perceive a situation can impact their ability to adapt, respond, and cope to the given experience,
and can therefore mediate the impact of psychological stress. Similarly, Lazarus and Folkman
(1984) described a transactional model of stress which is defined as “a particular relationship
between the person and the environment that is appraised by the individual as taxing or
exceeding his or her resources and endangering his or her well-being” (p. 19). Thus, it is
important to consider one’s appraisal of the stressful situation as well as one’s available coping
resources when assessing their ability to effectively cope with a particular stressor.

Although there are a number of strategies that are traditionally used to cope with stress,
including relaxation techniques, promotion of a healthy lifestyle, and cognitive-behavioral
therapies (e.g., stress inoculation therapy, rational emotive therapy, cognitive restructuring, and
behavioral rehearsal), these strategies often require significant professional training and expertise
to administer, as well as people, time, and resources, which can be difficult to achieve. To
overcome these limits, self-help approaches and telehealth-based treatments are being developed
in an attempt to enhance treatment fidelity, effectiveness, and accessibility (Ackerman, Filart,
Burgess, Lee, & Poropatich, 2010; Cusack et al., 2008; Oliver & Demiris, 2010; VandenBos &
In addition, interest in mobile applications for health promotion and disease self-management is growing (Plaza et al., 2013). In particular, mobile phones are gaining particular importance in health care services (Free et al., 2010; Kumar et al., 2013), as there appears to be a large increase in the use of mobile phones for a variety of therapeutic applications (Preziosa, Grassi, Gaggioli, & Riva, 2009). According to Cleland, Caldow, and Ryan (2007), among the many advantages of using a mobile approach to reduce stress could include both an incremental acquisition of coping skills in a more autonomous way, as well as allowing for a more ubiquitous and effective support in facing daily stressful situations. Moreover, thanks to the recent progress in the sophistication and usability of biosensors and other assessment and monitoring technologies (e.g., smartphone applications measuring salivary cortisol, heart rate variability, etc.), it is becoming possible to devise a multimodal assessment of stress levels, which can include psychological, physiological, behavioral, and contextual data (Gaggioli et al., 2013). In addition to an increasing interest in mobile applications for health, interest in mindfulness has increased exponentially over the last decade, particularly in the fields of psychology and medicine.  

Mindfulness (MF) is defined as an intentional nonjudgmental awareness of present-moment experiences such as thoughts, feelings, and body sensations (e.g., Baer, 2003; Kabat-Zinn, 2003). The trait or state of mindfulness is significantly related to several indicators of psychological health, and mindfulness-based therapies have been found to be effective at preventing and treating many chronic diseases (Plaza et al., 2013). Over the past two decades, there is strong evidence for the use of mindfulness-based interventions for the
treatment of depression, anxiety, and stress-related physical symptoms (Edenfield & Saeed, 2012). Results from meta-analyses suggest that mindfulness is effective in reducing psychological distress, including symptoms of anxiety and depression, in both nonclinical populations (Chiesa & Serretti, 2009) and clinical populations including eating disorders, heart disease, chronic pain, and diabetes (Bohlmeijer, Prenger, Taal, & Cuijpers, 2010).

It is believed that MF can be cultivated, and can be effective for strengthening coping ability and reducing levels of stress (Bishop et al., 2004; Brown & Ryan, 2003; Chase, 2009). Holzel et al. (2011) described a process involving multiple mechanisms, including attention-regulation, body awareness, emotion regulation (including reappraisal and exposure, extinction, and reconsolidation), and change in perspective on the self that work synergistically to facilitate a process of enhanced self-regulation. When an emotional reaction gets triggered by thoughts, sensations, memories, or external stimuli (e.g., a memory of a frightening event), the executive attention system detects the conflict to the task goal of maintaining a mindful state. Heightened body awareness helps to detect physiological aspects of the feelings present (e.g., body tension, rapid heartbeat, short shallow breath), which can help to identify triggers for various emotional responses (i.e., fear). Emotion regulation processes then become engaged, in order to relate to the experience differently rather than with a habitual reaction (i.e., simply noticing the fear as opposed to engaging in avoidance mechanisms). The first two mechanisms (heightened attention-regulation, and body awareness) lead to a situation of exposure, and the third mechanism (regulating for nonreactivity) facilitates response prevention, leading to extinction and reconsolidation (Holzel et al., 2011).

Thus, rather than being stuck in the habitual reactions to the external and internal environment, the mindfulness practitioner can experience the transitory nature of their thoughts,
sensations, or emotions in each moment of experience. According to Holzel et al. (2011), the awareness of the transitory nature of the self and one’s momentary experience leads to a change in the perspective on the self, where self-referential processing (i.e., the narrative of the relevance of the stimulus for oneself) becomes diminished, while first-person experiencing becomes enhanced. The entire process represents enhanced self-regulation, which, according to Karoly (1993) is defined as a process that enables individuals to guide their goal-directed activities by modulation of thought, affect, behavior, or attention via deliberate or automated use of specific mechanisms (Holzel et al., 2011).

**Rationale of the study**

While there is ample evidence illustrating the many benefits of mindfulness-based interventions for both clinical and nonclinical populations, the vast majority of these programs are time intensive, requiring both in- and out-of-session practice, and can be difficult for people with minimal experience with meditation. According to Carmody and Baer (2009), the consequence of this commitment could cause barriers to its widespread application. To overcome these limits, brief mindfulness meditation protocols have been developed and their efficacy supported for nonclinical populations who are at risk for stress-related health problems (Klatt, Buckworth, & Malarkey, 2009; Olivo et al., 2009; Tang et al., 2009). Nevertheless, only a few studies have integrated them in self-help interventions supported by new technologies such as mobile apps (Carissoli, Villani, & Riva, 2015), and despite the growing interest, research on both the design and potential uses of mindfulness-based mobile applications is scarce (Plaza et al., 2013).

Therefore, one of the primary aims of this study was to test the effectiveness of a brief self-help protocol using a mindfulness training application delivered via smartphone in reducing
stress in a university student population. The Mindfulness App (designed by MindApps at a cost of $2.99 to the consumer; the website, overview and downloading information can be found at http://www.mindapps.se/themindfulnessapp/) features guided meditations of varying length from 3 to 30 minutes, silent meditations with bells, personalized meditations with or without guided intro and bells, a reminder function to meditate, mindfulness notices that help you to increase your presence in the moment, and a “store” with guided meditations by some of the world’s most influential meditation teachers. There is also a statistics section to help keep track of a user’s meditations (e.g., minutes per week/month/year), which can be helpful both for the users as well as for researchers (“MindApps,” n.d.). The Mindfulness App appears to be a relatively simple, cost-effective, accessible, and private self-help tool that may help individuals to manage their stress more effectively. However, despite the many promising aspects of the application, the effectiveness of it for managing stress still needed to be explored.

Research Questions

Research questions are as follows:

1. Can four-week smartphone-based mindfulness app training reduce stress levels in a university student population?

2. Can four-week smartphone-based mindfulness app training reduce levels of stereotype threat (gender stigma consciousness or ethnicity stigma consciousness) in a university population?

3. Can four-week smartphone-based mindfulness app training foster more adaptive coping in a university population?

Study hypotheses are as follows:
1. Students who utilize the MF training app will have higher ratings of MF as compared to students who do not (i.e. vs. the control group).

2. Students who utilize the MF training app will have lower ratings of (psychological) perceived stress as compared to students who do not (i.e. vs. the control group).

3. Students who utilize the MF training app will have lower ratings of physiological stress (i.e., higher HRV) as compared to students who do not (i.e. vs. the control group).

4. Students who utilize the MF training app will have lower ratings of stereotype threat (gender stigma consciousness) as compared to students who do not (i.e. vs. the control group).

5. Students who utilize the MF training app will have lower ratings of stereotype threat (ethnicity stigma consciousness) as compared to students who do not (i.e. vs. the control group).

6. Students who utilize the MF training app will have increased positive coping styles (i.e. higher active coping; lower denial and behavioral disengagement) as compared to students who do not (i.e. vs. the control group).

**Research Design**

To reach this aim for our study, a controlled pragmatic trial was used. These types of trials are typically designed to test the effectiveness of interventions in real life in order to maximize their applicability and generalizability (Patsopoulos, 2011). As a pilot study, we utilized this small scale preliminary study to evaluate factors such as feasibility, time, cost,
potential adverse events, and effect size in an attempt to predict an appropriate sample size and improve upon the study design prior to performance of any full-scale or derivative research projects.

The brief self-help protocol using the mindfulness training app intervention (treatment group) will be compared with a non-treatment (non-mindfulness) control group. The rationale for mindfulness is that mindfulness is considered to be a qualitatively different phenomenon compared to some of the more frequently utilized stress coping mechanisms of today’s generation of college students, such as listening to music, sleeping, socializing, and relaxing (Bland, Melton, Welle, & Bigham, 2012). Although mindfulness can be relaxing, it is not considered a self-relaxation technique (Baer, 2003), but rather a form of mental training that facilitates more adaptive responding to stress (Bishop, 2002).

A convenience sample was used, recruiting both undergraduate and graduate students from a mid- to large-sized university in the northeastern United States. The sample characteristics of both groups strived to reflect typical undergraduate and graduate students. Both groups were given a short orientation which will included a basic introduction and overview of their respective interventions (approximately 10 minutes), as well as completion of any necessary paperwork (e.g., consent forms, contracts, etc.) and baseline measures (approximately 20 minutes). Participants then independently followed a 4-week protocol for their respective interventions (requiring approximately 15 minutes per day; or approximately 90 minutes per week for the mindfulness group), and then completed post-intervention measures and final paperwork at the end of their 4-weeks (for greater detail see Appendix I: Protocol Summary).
The two groups were assessed on pre- and post-intervention measures of mindfulness, using the Cognitive and Affective Mindfulness Scale–Revised (CAMS-R; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007); psychological stress, using the Perceived Stress Scale (PSS-10; Cohen, Kamarck, & Mermelstein, 1983); physiological stress using a Heart Rate Variability measure; stereotype threat (gender stigma consciousness and ethnicity stigma consciousness), using the Social Identities and Attitudes Scale (SIAS; Picho & Brown, 2011); and coping style, using the Brief COPE (Brief COPE; Carver, 1997).

The two groups were compared at baseline to determine if there are any significant differences for any of the factors. Next, a one-way analysis of covariance (ANCOVA) was used to assess for any post-test group differences for mindfulness, psychological stress, physiological stress, stereotype threat (gender stigma consciousness and ethnicity stigma consciousness), and coping style (active coping, denial, and behavioral disengagement), using pre-test scores on each measure as a covariate.

In addition to quantitative measures, the users’ experience with the mindfulness intervention was assessed post-intervention, particularly in regard to difficulty and perceived usefulness of the intervention. To assess the level of difficulty and the perceived usefulness of the intervention, three items rated on a 5-point Likert scale were used. The question related to difficulty asked participants “how did you find the tasks required by the intervention?” (1 = “very difficult”, 5 = “very easy”). The questions related to usefulness asked “did you find the intervention useful?” and “would you suggest this type of practice for stress management?” (1 = “strongly disagree”, 5 = “strongly agree”). Finally, six open-ended questions were asked post-intervention to assess the role of diversity in mindfulness training. The open-ended questions asked participants to “Please discuss if and how this research on mindfulness assisted you in
dealing with each of the following areas: 1) racial discrimination, 2) gender discrimination, 3) economic strain, 4) acculturation issues/immigration issues (i.e., adapting to the local culture; including school, campus, city, state, country), and 5) academic achievement”, and 6) “What, if anything, did you like about the intervention?”. We explored participants’ responses to the open-ended questions to explore whether any themes or patterns had emerged. Additionally, the open-ended questions helped to provide contextual information for our research questions, as well as helping to provide specific examples of how the intervention may have impacted the various areas of participants’ lives.
Stress in American Society

Psychological stress is ubiquitous in American society. *Psychological stress* is defined as when a person believes that environmental demands exceed his or her adaptive capacity (Cohen, Janicki-Deverts, & Miller, 2007).

The NPR/Robert Wood Johnson Foundation/Harvard School of Public Health Burden of Stress in America Survey was conducted in 2014, with a sample of 2,505 respondents. The survey examined the role stress plays in different aspects of Americans’ lives, including the public’s personal experiences of stress in the past month and year, the perceived effects of their stress and causes of that stress, their methods of stress management and their general attitudes about effects of stress in people’s lives (NPR/RWJ Foundation, 2014). Their results indicated that 49 percent of Americans reported having a “major stressful event or experience” in the past year, and 26 percent reported a “great deal of stress” within the past month. People who reported experiencing a great deal of stress in the past month say it affected their family life (75 percent), their health (74 percent), their work (70 percent), and their social life (68 percent). The most commonly reported effect on health among those under a great deal of stress in the last month were negative effects on emotional well-being (63 percent), problems with sleep (56 percent) and difficulty in thinking, concentrating or making decisions (50 percent).

In addition to being rather commonplace, psychological stress appears to be on the rise in American society. Cohen and Janicki-Deverts (2012) investigated whether the distributions of stress across demographics were constant over a 26-year period, ranging from 1983-2009. Their results showed a 10-30 percent increase in stress in all the demographic categories over the 26-year period. Additionally, over this time, stress increased 18 percent for women and 24
percent for men (Cohen & Janicki-Deverts, 2012). While there could be a number of factors contributing to this increase in stress levels, the researchers theorize that cultural and societal changes are likely the primary factors affecting these increases (Cohen & Janicki-Deverts, 2012). It is believed that the increased environmental demands (e.g., complexities, pressures, and general busyness) associated with modern society may be negatively impacting people’s ability to effectively cope with these demands. The impact of societal changes may be further illustrated in the NPR/RWJ survey (2014), as more than half of those who experienced a great deal of stress in the past month reported having too many overall responsibilities (54 percent). Other contributors were financial problems (53 percent), their own health problems (38 percent), health problems of family members (37 percent), problems with family members (32 percent), and negative feelings about their own appearance (28 percent). For those who are employed and experienced a great deal of stress, over half (53 percent) said problems at work contributed to their stress. Although the etiological factors associated with this societal-level increase in stress needs further exploration, the deleterious impacts of stress are becoming better understood.

**Stress and Health/Chronic Disease Risk**

The effects of stress on immune and inflammatory processes have the potential to influence depression, infectious diseases, autoimmune disorders, coronary artery disease, and some types of cancers. Specifically, psychological stress is thought to influence a wide range of physiological processes and disease states, with existing evidence supporting stress as a risk factor in depression (Hammen, 2005; Kessler, 1997; Mazure, 1998; Monroe & Simons, 1991), cardiovascular disease (Cohen, Janicki-Deverts, & Miller, 2007; Krantz & McCeney, 2002; Rozanski, Blumenthal, & Kaplan, 1999), diabetes (Cohen et al., 2007), HIV/AIDS (Cole & Kemeny, 2001; Pereira & Penedo, 2005), delayed wound healing (Kiecolt-Glaser, Marucha,
Malarkey, Mercado, & Glaser, 2001), upper respiratory infections (Miller & Cohen, 2005), autoimmune diseases (Cohen et al., 2007; Heijnen & Kavelaars, 2005), and total mortality (Neilsen, Kristensen, Schnohr, & Gronbaek, 2008). Additionally, individuals with higher psychological stress were associated with a higher failure to quit smoking; higher failure among diabetics to control blood sugar levels; a greater vulnerability to stressful life-event-elicited depressive symptoms, and having more colds (Cohen & Williamson, 1988). Additionally, chronic stress can undermine a variety of resiliency factors (Haglund, Nestadt, Cooper, Southwick, & Charney, 2007; Ong, Bergeman, Bisconti, & Wallace, 2006), as well as factors such as hope (Lopez, Snyder, & Pedrotti, 2003; Ong & Bergeman, 2004; Ong, Edwards, & Bergeman, 2006), and the capacity to forgive (Harris, & Thoresen, 2005).

The Unique Stress of Millennial College Students

Today’s generation of university students may be one particular group that is in need of more evidence-based methods for managing stress. Stress is a major issue for college students as they cope with academic, social, and personal challenges (Hudd, Dumlao, & Erdman, 2000; Hudd et al., 2000). Previous studies have found that younger people tend to have higher levels of perceived stress than their older adult counterparts (Hamarat et al., 2001), and the college years, in particular, have been deemed as one of the most stressful periods of a person's life (Hales, 2009).

Chronic stress has been associated with mental distress such as anxiety and depression (Hammen, 2005). Recent research has revealed concerning rates of anxiety and depression among university students, though, only a small percentage of these students receive treatment from university health services (Regehr, Glancy, & Pitts, 2013). Thus, in addition to finding
ways to make university health services more accessible, it may be helpful to find preventative programs that can help reduce student stress and the resultant anxiety and depression.

Although the stresses of college life have existed across multiple generations, the Millennial generation of college students is unique in characteristics, including the manner in which they handle stressors. *Millennials*, also known as generation Y, are those born after 1982 (Atkinson, 2004). They will make up close to 100 million people in the U.S., over 20 percent of today's population (Howe & Strauss, 2000). This is the largest generation since the Baby-Boomers, (approximately 33 percent larger than the Boomers, who were born between 1945 and 1960) (Weston, 2006). The Millennial generation poses unique characteristics compared to their previous cohort, and these characteristics can greatly impact both the types of stress these students face, as well as how they handle stress (Elam, Stratton, & Gibson, 2007).

At a 39% minority rate, the millennial generation is more ethnically diverse than either the Boomers or Generation X (Weston, 2006). Household income is higher, driven in large part by the fact that both parents are working. Families are smaller, with a median of one sibling and parents who waited until they were older to start having children. Millennial parents are also more educated. The percentage of parents holding a degree increased from 26% in 1973 to 42.5% in 1998 (Howe & Strauss, 2000). Millennials are unlike any previous generation in that they are more numerous and affluent, better educated and more ethnically diverse (Howe & Strauss, 2000). With greater diversity, there comes the potential for Millennial students to experience some unique stressors; including greater susceptibility to stereotype threat.

*Stereotype threat* (*ST*) is defined as the pressure resulting from social comparisons that are perceived as unfavourable (Weger et al., 2012). Individuals who experience stereotype threat show performance decrements across a wide range of tasks (Steele, 1997; Weger et al.,
According to ST theory, mere knowledge that a negative stereotype exists about a social group is enough to inhibit one’s performance on stereotype relevant tasks (Picho & Brown, 2011). For university students, stereotype threat can impact a variety of academic, social, and emotional areas, ranging from what major one chooses to pursue, to what social groups or clubs one chooses to associate with. However, in order for ST to occur one must: 1) believe the stereotype, and also 2) have a high personal investment in the stereotyped domain (e.g., females and minorities who value mathematics) (Steele, 1997). ST is offset by a cognitive imbalance between group and domain identification experienced by the individual (Schmader, Johns, & Forbes, 2008); the tension between these identities elicits negative affective responses like task-related worries (Beilock, Rydell, & McConnell, 2007) and anxiety (Steele & Aronson, 1995), which impair the working memory required for successful task completion, subsequently undermining performance.

Fortunately, ST does not impact all members of these stigmatized groups. For members belonging to these groups, ST is moderated by individual differences on other factors like group identification (Schmader, 2002), domain identification (Steele, 1997; Steele & Aronson, 1995), stigma consciousness (Brown & Pinel, 2003), and emotion regulation (Schmader et al., 2008). Hence individuals exhibiting high levels of the aforementioned factors are highly susceptible to ST effects and more likely to perform below their potential under ST conditions.

Although Millennials may demonstrate positive social habits that older Americans have often not associated with youth, such as habits of teamwork, achievement, modesty, and good conduct, they also have distinct negative attributes that impact their stressors and coping mechanisms, such as being over scheduled, heavily monitored, and pressured to excel academically (McGlynn, 2008). However, when faced with similar stressors, not all people
react in the same manner. Some are able to handle the stress, while others have great difficulty. The inability to cope with stress has been shown to negatively impact health behaviors in college students, including alcohol abuse, smoking, and eating disorders (Economos, Hildebrandt, & Hyatt, 2008; Oliver, Reed & Smith, 1998; Pritchard, Wilson, & Yarnitz, 2007). Several studies have also shown a decrease in the mental health status of college students due to stress, which contribute to increase in rates of depression (Benton et al.; Dyson & Renk, 2006; Yorgason, Lonville, & Zitzman) and lower self-esteem (Hudd et al., 2000).

When individuals make the transition from high school to college, they are faced with stressful academic, social, and personal challenges associated with adjusting to university life (Dyson & Renk, 2006; Oman, Chauna, Thoresen, Plante, & Flinders, 2008). While many are able to make the transition with success, others experience a great deal of difficulty. Therefore, it could be helpful to explore the various ways that students cope with these challenges.

Bland, Melton, Welle, and Bigham (2012) conducted a study to identify lifestyle habits and coping strategies that may be significantly associated with high or low stress tolerance among millennial college students. They utilized an epidemiological cross-sectional study of randomly selected college students (N=246) completed the Stress Tolerance Questionnaire (STQ), which was comprised of checklists for stressors, symptoms, and coping strategies. Stress tolerance ratios (STRs) were calculated, and subjects divided into high or low stress tolerance groups. Statistical differences were determined by Chi-Square and Odds Ratio (95%CI). They found that coping mechanisms and lifestyle habits currently employed by the Millennial college students are not only ineffective for alleviating stress, but also put these students at risk for low stress tolerance. Their findings indicated that Millennial students tend to rely upon both traditional ways and more contemporary methods to reduce stress. Listening to music was the
most frequently cited stress coping mechanism (95.1%, n=231), followed by sleep (93.4%, n=227), engaging in social interaction (93.4%, n=227) and relaxing (90.1%, n=219).

Contemporary coping strategies reported by Millennial students included surfing the internet (88.1%, n=214) and participating in internet social networks (86.0%, n=209).

Out of the 29 factors assessed in relation to stress tolerance, nine were found to be risk factors that put one more likely to suffer low stress tolerance (Bland et al., 2012). These nine factors included cleaned apartment, called a friend, prayed, used internet social networks, called mom, shopped, ate, and used substances. Of particular concern is that these risk factors all tend to rely on external coping sources, and thus could be defined as avoidant coping strategies.

Previous research identified avoidant coping strategies to include self-distraction, denial, or mental or behavioral disengagement (Dyson & Renk, 2006), and has found avoidance strategies to be associated with negative outcomes for individuals (McNamara, 2000). However, it is important to note distinctions between different types of avoidance strategies (e.g., use of unhealthy substances to “escape” one’s poor mood, or procrastinating a school assignment by watching excessive TV; versus things like talking on the phone to a loved one, which could depending on the circumstances be a way of avoiding other tasks, but which is generally thought of as a pleasurable, meaningful, “healthy” experience). Additionally, there are often times when balancing periods of more active coping with some periods of distraction can be considered very healthy. For example, individuals who suffer from chronic pain are typically encouraged to find ways of distracting from their pain, to both take their minds away from the pain, but also to help to decrease the symptoms themselves. Another example would be individuals who are repeatedly marginalized due to being members of a particular (minority) group (i.e., who all too often face a barrage of microaggressions, chronic oppression, racism, sexism, and bigotry, etc.),
who may over time have learned to use avoidant strategies as not only a means of coping, but often too as means of survival.

As exhibited by the results of this study, these coping mechanisms employed by an individual may be maladaptive dependent upon how one ultimately manages stress. The types of coping strategies as well as the corresponding approach or avoidant orientation used by the Millennial population may prove to be important and predictive of their stress tolerance and overall adjustment to the stressful college life. Given the unique characteristics of the Millennial college students, it is important to reinforce stress coping mechanisms that increase stress tolerance. This stress tolerance, or ability to be resilient to the impacts of stress, is related to both the way that a person appraises a situation, as well as the way that they learn to cope with the situation.

**Psychophysiology of Stress**

Lazarus and Folkman (1984) described a transactional model of stress which is defined as “a particular relationship between the person and the environment that is appraised by the individual as taxing or exceeding his or her resources and endangering his or her well-being” (p. 19). They argued that stress consists of three processes: primary appraisal, secondary appraisal, and coping. **Primary appraisal** is the process in which one perceives a threat to self. **Secondary appraisal** is the process in which one brings to mind a potential response to that threat and, lastly, **coping** is the process of executing that response. It is believed that this three-process approach is not linear in nature and may cycle repeatedly during a stressful situation.

Stressful events are thought to influence the pathogenesis of physical disease by causing negative affective states (e.g., feelings of anxiety and depression), which in turn exert direct effects on biological processes or behavioral patterns that influence disease risk. Exposures to
chronic stress are considered the most toxic because they are most likely to result in long-term or permanent changes in the emotional, physiological, and behavioral responses that influence susceptibility to and course of disease (McEwen, 2008). Stress begins in the brain and affects the brain, as well as the rest of the body. Although acute stress responses promote adaptation and survival via responses of neural, cardiovascular, autonomic, immune and metabolic systems (McEwen, 2008), chronic stress can promote and exacerbate pathophysiology through the same dysregulated systems. The burden of chronic stress and accompanying changes in personal behaviors (smoking, eating too much, drinking, poor quality sleep; otherwise referred to as “lifestyle”) is called allostatic overload (McEwen, 2008). Brain regions such as hippocampus, prefrontal cortex and amygdala respond to acute and chronic stress and can show changes in morphology and chemistry following periods of chronic stress (McEwen, 2008).

Since psychological stress involves the way a person believes that environmental demands exceed his or her adaptive capacity, it may be helpful to intentionally seek to reduce the overall demands in one’s life. However, while simplifying one’s life could be helpful in trying to manage stress, it is difficult to completely eliminate the numerous environmental demands that are an inherent part of life in American society. Thus, if it is not plausible to eliminate stress completely, it becomes even more necessary to learn how to effectively manage and/or cope with these environmental demands.

Concordantly, while only 14 percent of respondents in the Burden of Stress in America Survey (NPR/RWJ Foundation, 2014) reported having “no stress” within the past month, nearly three-quarters (74 percent) of those reported that they feel they have a great deal of control over the stress in their life. Therefore, it is important to develop evidence-based methods that can help individuals to feel a sense of control over the stress in their lives, which can help to better
psychologically cope with stress, as well as minimize the negative psychological and physiological impacts of stress.

**Mindfulness Overview**

One particular area that has been shown to be effective in managing stress is mindfulness. *Mindfulness (MF)* is defined as an intentional nonjudgmental awareness of present-moment experiences such as thoughts, feelings, and body sensations (e.g., Baer, 2003; Kabat-Zinn, 2003). MF is typically cultivated in formal meditation practices, such as sitting meditation, walking meditation, or mindful movements. The practice of MF meditation encompasses focusing attention on the experience of thoughts, emotions, and body sensations, simply observing them as they arise and pass away. During MF meditation, the meditator’s goal is to maintain attention to current internal and external experiences with a nonjudgmental stance, manifesting acceptance, curiosity, and openness (Holzel et al., 2011).

Although MF practice may have its roots in ancient Eastern philosophy, interest in the West is growing, particularly in the fields of psychology and medicine (Plaza et al., 2013). MF has been found to be related to several indicators of psychological health, including anxiety (Hofmann, Sawyer, Witt, & Oh, 2010; Roemer, Orsillo, & Salters-Pedneault, 2008), depression (Hofmann et al., 2010; Teasdale et al., 2000), substance abuse (Bowen, 2012; Bowen et al., 2006), eating disorders (Tapper et al., 2009), and chronic pain (Grossman, Tiefenthaler-Gilmer, Raysz, & Kesper, 2007). Furthermore, MF meditation has been found to have a positive influence on numerous areas of physical health, including improved immune function (Carlson, Speca, Faris, & Patel, 2007; Davidson et al., 2003), and reduced blood pressure and cortisol levels (Carlson et al., 2007); and thus may be effective at preventing and treating many chronic diseases (Plaza et al., 2013). There is strong evidence supporting the use of MF interventions
for the treatment of depression, anxiety, and stress-related physical symptoms (Edenfield & Saeed, 2012), and results from meta-analyses suggest that MF can be effective in reducing psychological distress, including symptoms of anxiety and depression, in both nonclinical populations (Chiesa & Serretti, 2009) and clinical populations including eating disorders, heart disease, chronic pain, and diabetes, among others (Bohlmeijer, Prenger, Taal, & Cuijpers, 2010). Not only has mindfulness successfully been used in the treatment of disorders and improvement of health; it has also been shown to produce positive effects on psychological wellbeing in healthy participants (Carmody & Baer, 2008; Chiesa & Serretti, 2009) and may help to enhance cognitive functioning (Jha, Krompinger, & Baime, 2007; Ortner, Kilner, & Zelazo, 2007; Pagnoni & Cekic, 2007; Slagter et al., 2007).

It is believed that MF can be effective for strengthening coping and reducing levels of stress and emotional distress for those who attain higher levels of MF (Bishop et al., 2004; Brown & Ryan, 2003; Chase, 2009). In particular, MF may help in the process of disengaging people from their automatic thoughts, habits and unhealthy patterns of behavior. As a result, MF can help to foster more effective behavioral regulation, which has been associated with overall enhancement in well-being (Brown & Ryan, 2003; Chase, 2009).

One of the challenges of studying MF is that there are many differing definitions of MF that encompass a wide range of variables. Additionally, MF is often used to describe many different things, including a theoretical construct, a practice of cultivating mindfulness, a psychological process, a cognitive style, a state, or a personality trait (Chase, 2009; Germer, 2005). The conceptualization of mindfulness within the state-trait distinction is one that can be understood as the regularity with which a person experiences mindful states of consciousness. For example, the trait-based line of thought is that if there is a consistent and prolonged
maintenance of a consistent level of MF, then MF might be better conceptualized as a personality “trait” (Chase, 2009; Germer, 2005). Thus, one can consider trait MF as a person’s tendency to be aware of and attentive to present moment experiences in daily life (Brown & Ryan, 2003). The state-based line of thought argues that a person may go in and out of mindful and more mindless or automatic states hundreds of times within a day and that there are intra-individual differences in a person’s tendency to spend more or less time in a mindful state. Although these conceptualizations are not mutually exclusive, they typically represent different lines of research, and can pose challenges to the way MF is defined and conceptualized.

In addition to the varying definitions and conceptualizations of MF, there is not currently a single, unifying theoretical framework for studying MF. Holzel et al. (2011) point out that, “although there is currently a large body of literature, covering a wide range of research, including qualitative research, feasibility trials, controlled clinical trials, behavioral studies, and neuro-scientific research, there is a relative paucity of theoretical reviews that consolidate the existing literature into a comprehensive theoretical framework” (p. 538). Therefore, there have been a number of different models that have been used to study MF.

For example, Bishop et al. (2004) suggested a two-component model of mindfulness, where the first component is the regulation of attention in order to maintain it on the immediate experience, and the second component involves approaching one’s experiences with an orientation of curiosity, openness, and acceptance, regardless of their valence and desirability. Similarly, Brown, West, Loverich & Biegel (2011) described two conceptualizations of mindfulness, where the first conceptualization involves a sustained receptive attention to present events and experiences, while the second involves an open, assimilative “wakefulness” to
cognitive tasks, in which thought is used to flexibly create new categories, draw distinctions, and seek multiple perspectives.

Holzel et al. (2011) described an integrated model involving multiple mechanisms, including attention-regulation, body awareness, emotion regulation (including reappraisal and exposure, extinction, and reconsolidation), and change in perspective on the self that work synergistically to facilitate a process of enhanced self-regulation. When an emotional reaction gets triggered by thoughts, sensations, memories, or external stimuli, the executive attention system detects the conflict to the task goal of maintaining a “mindful state.” This can be done in a variety of ways, but typically involves an intentional directed attention to the breath (used as an “anchor”). Next, heightened body awareness helps to detect physiological aspects of the feelings or sensations that are present (e.g., body tension, rapid heartbeat, tightness, stiffness, short shallow breath, etc.), and then the provided information about the internal reaction to the stimulus becomes a prerequisite for accurate identification of the triggered emotional response (e.g., fear). Next, emotion regulation processes become engaged in order to relate to the experience differently rather than with a habitual reaction (i.e., simply noticing the fear as opposed to engaging in avoidance mechanisms; being on “autopilot”).

Put into behavioral terms, the first two mechanisms (sustained attention and body awareness) lead to a situation of exposure, and the third mechanism (regulating for nonreactivity) facilitates response prevention, leading to extinction and reconsolidation. Rather than being stuck in the habitual reactions to the external and internal environment, the meditator can experience the transitory nature of all related perceptions, emotions, or cognitions in each moment of experience. The awareness of the transitory nature of the self and one’s momentary experience leads to a change in the perspective on the self, where self-referential processing (i.e., the
narrative of the relevance of the stimulus for oneself) becomes diminished while first-person experiencing becomes enhanced (Holzel et al., 2011). The entire process represents enhanced self-regulation, which, according to Karoly (1993), is defined as a process that enables individuals to guide their goal-directed activities by modulation of thought, affect, behavior, or attention via deliberate or automated use of specific mechanisms (Holzel et al., 2011).

**Mindfulness and University Students**

A meta-analysis conducted by Regehr et al. (2013) examined the effectiveness of interventions aimed at reducing stress in university students. Twenty-nine controlled trials on stress interventions for university students met the criteria for inclusion in the meta-analysis. Controlled trial studies covered students in a wide range of disciplines, including nursing, medical science, medicine, economics, social work, law, psychology, technology, and general arts and science. While the majority of controlled trial studies (19) involved students in the United States, studies also included students in Tehran, Switzerland, Jordan, England, Iran, and Tasmania. The combined controlled trials had 1802 student participants. Of the total number of participants in these studies, 24.7% were male, 72.4% were female, and in 2.8% of the cases gender was not reported. Thus in the reported cases 25.5% of participants were male. For the purposes of meta-analysis, stress interventions were grouped into three broad categories: 1) arts-based interventions; 2) psycho-educational interventions; and (3) cognitive behavioral and/or mindfulness-based interventions. They found that cognitive, behavioral and mindfulness interventions were associated with decreased symptoms of anxiety. Secondary outcomes included lower levels of depression and cortisol. The researchers found that despite variations in approaches in terms of length of intervention and specific components of the intervention (including such aspects as cognitive restructuring, relaxation, and meditation) with students in
different programs and in different countries, these results are remarkably consistent. Although there are noted limitations to this meta-analysis, including a high representation of female participants from Western countries, and insufficient data for arts-based and psycho-educational interventions, this review provides evidence that a variety of different cognitive, behavioral, and mindfulness interventions can be effective in reducing stress in university students.

Further research suggests that mindfulness and mindfulness-based interventions correlate with and have positive effects on various aspects of youth and adults well-being (Brown & Ryan, 2003; Perolini, 2011). Various physical and psychological health changes, including increased cerebral blood flow (Benson, Alexander, & Feldman, 1975), reductions in metabolic activity, heart and respiratory rates, blood pressure, oxygen consumption (Benson, Dryer, & Hartley, 1978); and muscle tension (Benson, Kotch, & Crassweller, 1978), have been empirically linked to the practice of meditation, particularly mindfulness meditation. Additionally, mindfulness has been significantly correlated with lower perceived stress, less high-risk health behaviors and higher self-efficacy within college students (Araas, 2008).

One of the theorized mechanisms which may account for the effect of stereotype threat (ST) is that the cognitive pressure triggered by such threat drains the same cognitive (or working-memory) resources that are implicated in the respective task. A study by Weger et al. (2012) investigated whether mindfulness could be used to moderate stereotype threat, as mindfulness has previously been shown to alleviate working-memory load. Their results showed that performance decrements that typically occur under stereotype threat can be reversed when the individual engages in a brief 5-minute mindfulness task. It is possible that both longer and/or more frequent mindfulness training could further heighten this effect.
Although mindfulness may be a promising method for reducing stereotype threat, there are very few studies that have explored this approach. A study by Hayes et al. (2004) compared both a mindfulness-based intervention and a multicultural training intervention to a biologically-oriented educational control condition in the alleviation of stigmatizing attitudes in drug abuse counselors. All of the interventions were based on a 1-day workshop of equal duration. The mindfulness-based intervention, derived from Acceptance and Commitment Training (ACT), utilized acceptance, defusion, mindfulness, and values methods. Whereas, the multicultural training sensitized participants to group prejudices and biases. Measures of stigma and burnout were taken pre-training, post-training, and after a 3-month follow-up. Results showed that the multicultural training had an impact on stigmatizing attitudes and burnout post-intervention but not at follow-up, but showed better gains in a sense of personal accomplishment as compared to the educational control at follow-up. Conversely, the mindfulness-based intervention (ACT) had a positive impact on stigma at follow-up, on burnout at post-treatment, and follow-up, follow-up gains in burnout exceeded those of multicultural training. The mindfulness-based intervention (ACT) also exhibited significant changes in the believability of stigmatizing attitudes. This process mediated the impact of ACT, but not multicultural training, on follow-up stigma and burnout. While this preliminary study was primarily focused on reducing stigma and burnout in behavioral health counselors, the results show some evidence that mindfulness-based interventions can help to reduce stigma, and could potentially help to moderate the impact of stereotype threat for additional populations.

**mHealth Technologies**

Interest in mobile applications for health promotion and disease self-management is growing (Plaza et al., 2013). Although there are a number of strategies typically used to cope
with stress, including relaxation techniques, promotion of a healthy lifestyle, and cognitive-behavioral therapies (e.g., stress inoculation therapy, rational emotive therapy, cognitive restructuring, and behavioral rehearsal), these strategies often require significant professional training and expertise to administer, as well as people, time, and resources, which can be difficult to achieve. To overcome these limits, self-help approaches and telehealth-based treatments are being developed in an attempt to enhance treatment fidelity, effectiveness, and accessibility (Ackerman, Filart, Burgess, Lee, & Poropatich, 2010; Cusack et al., 2008; Oliver & Demiris, 2010; VandenBos & Williams, 2000), and may help to bridge the gap of people that could benefit from health-related interventions but are not currently using traditional university health services.

In particular, mobile phones are gaining particular importance in health care services (Free et al., 2010; Kumar et al., 2013), as there appears to be a large increase in the use of mobile phones for a variety of therapeutic applications (Preziosa, Grassi, Gaggioli, & Riva, 2009). Some of these areas include the use of mobile phones for managing exam stress (Preziosa, Grassi, Gaggioli, & Riva, 2009), a mobile-based stress-management program for employees (Heber et al., 2013), and a mobile-based program for reducing stress during commuting trips (Grassi, Gaggioli, & Riva, 2009). According to Cleland, Caldow, and Ryan (2007), among the many advantages of using a mobile approach to reduce stress could include: 1) an acquisition of coping skills in a more autonomous way, 2) allowing for a more ubiquitous and effective support in facing daily stressful situations, 3) an enhancement of people’s compliance, and 4) the possibility of living graded exposure experiences in real-world settings. Moreover, thanks to the recent progress in the sophistication and usability of biosensors and other assessment and monitoring technologies (e.g., smartphone applications measuring salivary
cortisol, heart rate variability, etc.), it is becoming possible to devise a multimodal assessment of stress levels, which can include psychological, physiological, behavioral, and contextual data (Gaggioli et al., 2013). However, despite the growing interest, research on both the design and potential uses of mindfulness-based mobile applications (MBMAs) is scarce (Plaza et al., 2013).

Plaza et al. (2013) suggest that this lack of evidence is probably because both mobile-based technologies (MBTs) and their related mobile apps are in their early technological development phase, and because developers in the vendors market are not involved in academic or health settings. This means that the industry could benefit from greater interdisciplinary research and entrepreneurship in all phases of development and evaluation. Pilot studies may be a particularly suitable method for the initial testing and evaluation of smartphone apps and other mHealth-related programs, as things such as usability and acceptability are important factors that could impact whether individuals will ultimately adopt or utilize a particular program.

Therefore, pilot studies have been utilized to evaluate a variety of mHealth technologies, including a pilot study to assess the usability and acceptability of a smartphone app (“MindSurf”) designed to promote contentment, wellbeing, and goal achievement (Carey, Haviland, Tai, Vanags, & Mansell, 2016), adherence to a smartphone app for smoking cessation (Zeng, Heffner, Copeland, Mull, & Bricker, 2016), and using a smartphone app to promote psychiatric and physical well-being (Macias et al., 2015), among others. The overall rationale is that unlike the more established treatment protocols, delivered in more traditional settings, many mHealth-related technologies are often relatively new to the market and are by their very nature delivered in less traditional formats. Therefore, it is important to evaluate such things as usability and acceptability, since it may not matter whether a program is effective for its
intended purpose (e.g., stress management, smoking cessation, etc.) if prospective users find it too difficult or costly to use.

**Developing Brief and Effective Mindfulness Interventions**

In general, mindfulness has been around for a while and numerous anecdotal accounts lay claim to the many benefits that it can have. However, the development and evaluation of brief yet effective mindfulness interventions is still in its infancy. One of the more reputable programs in this area is that of mindfulness-based stress reduction (MBSR). MBSR has been around since the early 1990s and is a clinically standardized meditation that has shown consistent efficacy for many mental and physical disorders (Praissman, 2008). MBSR has been found helpful in reducing blood pressure levels and blood pressure reactivity to stress (Nyklicek, Mommersteeg, Van Beugen, Ramakers, & Van Boxtel, 2013).

Originally, MBSR was designed to be long enough for participants to learn self-regulation through mindfulness and develop greater skill and autonomy in mindfulness practice. It traditionally consists of 26 hours of session time including eight classes of 2-1/2 hours and an all-day class. The circumstances of some groups could create barriers for participating, thus highlighting a desire for abbreviated class times. Carmody and Baer (2009) explored whether lower program time demands could lead to similar outcomes in psychological functioning. They examined effect sizes for psychological outcome variables (including general distress or global severity of psychological symptoms, negative mood or affect, stress, depression, and anxiety) in published studies of mindfulness-based stress-reduction (MBSR), some of which had adapted the standard number of class hours. The most frequent number of sessions was eight (24 of 29 studies, or 83%). Length of weekly sessions ranged from 1 hour (1 study) to 2.5 hours (10 studies). The mode was 2.0 hours (12 studies), and the mean was 121 minutes. Seven
studies used sessions of 1.5 hours. The all-day (or in some cases, half-day) session was included in 13 of 30 studies (43%). Length of this session ranged from 3 to 8 hours. Three of these studies used half-day sessions (3.0 or 3.5 hours), whereas 10 included sessions of 6–8 hours. Total in-class hours, including the all-day or half-day if it was held, ranged from 6 (one study) to 28 (two studies) with a mean of 18.8 hours (SD=55.90 hours). The median was 17.7 hours and the mode was 16 hours (7 studies). When computed in the entire sample of 30 studies, the correlation between mean pre- and post-treatment effect size and number of in-class hours was non-significant (r=-0.25, p=0.18). Although statistically non-significant, the magnitude of the correlation falls within a range that would be significant with a somewhat larger sample (Cohen, 1977). The relationship also is in the unexpected direction (with longer versions of MBSR showing smaller effects). The researchers point out that this surprising finding could be related to two studies, whose mean effect sizes fell more than two standard deviations above the mean for all studies and therefore might be considered outliers. These studies had mean effect sizes of 1.37 and 1.38, respectively, and both included only 12 in-class hours, which falls near the low end of the distribution. When this analysis was repeated with these two outliers removed, the correlation again was non-significant (r=-0.08, p=0.69), and was small enough to be clinically or practically meaningless even in a very large sample. The results of this study suggest that adaptations that include less class time may be worthwhile for populations for whom reduction of psychological distress is an important goal and for whom longer time commitment may be a barrier to their ability or willingness to participate (Carmody & Baer, 2009).

Another study by Baer, Carmody, and Hunsinger (2012) examined weekly change in self-reported mindfulness and perceived stress in participants who completed an 8-week course in mindfulness-based stress reduction (MBSR). Participants were 87 adults with problematic
levels of stress related to chronic illness, chronic pain, and other life circumstances who participated in MBSR at an academic medical center. Participants’ mean age was 48.83 years (SD=10.60, range=24-79) and 67% were female. Most (67%, n = 58) were married or cohabitating, whereas 12.6% (n = 11) were single, 12.6% (n= 11) were separated, divorced, or widowed, and 8% (n=7) did not answer this question. Most participants reported white collar and professional occupations. No racial or ethnic demographics were given in the study. The participants completed weekly self-report assessments of mindfulness skills and perceived stress. The researchers hypothesized that significant improvement in mindfulness skills would precede significant change in stress. They found that mindfulness skills and perceived stress both changed significantly from pre-treatment to post-treatment; and that significant increases in mindfulness occurred by the second week of the program, whereas significant improvements in perceived stress did not occur until week four. Thus, the extent of change in mindfulness skills during the first three weeks predicted change in perceived stress over the course of the intervention.

The study provides evidence that changes in mindfulness precede changes in perceived stress in a standard MBSR course is consistent with previous studies suggesting that improvements in mindfulness skills may mediate the effects of mindfulness training on mental health outcomes (Baer et al., 2012). This study also has implications in discovering the most cost-effective length of intervention; which can still produce similarly desirable health effects, yet within a shorter and more accessible time frame.

One particular study sought to reduce this timeframe down to three weeks, using a mindfulness-based protocol delivered via smartphone. Carissoli, Villani, and Riva (2015) explored the efficacy of a 3-week mindfulness protocol delivered via smartphone in reducing
stress in an adult population. Their sample included 56 (Female=32) Italian workers that were recruited from the Greater-Milan (Italy) area. The ages of the participants ranged from 20-52 years (M=38.11, SD=6.92). Approximately 32.1 percent had a high school diploma, 66.1 percent had a college degree; and approximately 2/3 of the sample was considered to have white-collar jobs (e.g., consultants, salespeople, entrepreneurs, etc.). The recruitment criteria were as follows: 1) > 18 years old, 2) employed, and 3) a native Italian speaker. The participants were divided into three different conditions (mindfulness group, relaxation/music group control group, and a waitlist control group). The mindfulness group was instructed to practice mindfulness meditations two times per day, lasting 15 minutes each. They were free to choose from guided or free meditations that were supported by the smartphone app “It’s time to relax!” Music listeners had to use their mobile device to listen to two pieces of relaxing music (chosen from a proposed list); lasting 15 minutes each, while doing nothing else. The waitlist group with no intervention was assessed at the same time as the other two groups, that is, before and after the full interventions. They assessed perceived stress using the Mesure du Stress Psychologique (MSP) at the beginning and end of the protocols. The MSP evaluates perceived stress within the preceding three months, and includes 49 items in six different dimensions, including, loss of control and irritability, psychophysiological feelings, sense of effort and confusion, depressive anxiety, pain and physical problems, and hyperactivity and accelerated behaviors. The Italian version possesses a Cronbach’s alpha of 0.95, exhibiting strong reliability. In addition to perceived stress, heart rate was tracked daily (by the participants; before and after each session). In addition, participants were surveyed at the completion of their respective protocols about the “ease of use” and “usefulness” of the intervention, using a five-point Likert scale. Questions related to difficulty were “How did you find the tasks required by the testing?” and “How did
you find the detection of heartbeats?” (1= “very difficult”, 5=”very easy”). Questions related to usefulness were “Did you find the trial useful?” and “Would you suggest this type of practice for stress management?” To obtain a composite measure, the sum of the two items was averaged for a single mean score.

Their results did not show any significant differences between groups, but both the mindfulness and relaxation/music group demonstrated improvements in coping with stress compared to the waitlist group (who experienced an increase in perceived stress). Both the mindfulness group and relaxation/music group reported a significant decrease in average heartbeats per minute after each session. Both groups evaluated the interventions as simple (meditation: M=3.65; music: M=2.08) and useful (meditation: M=3.65; music: M=3.61).

Although both the mindfulness and relaxation/music group showed improvements in stress response, the researchers believed that having duration greater than three weeks could produce a more significant effect for the mindfulness group, as it may take some time to get comfortable with the practice and to let the psychological and physiological benefits set in. Other limitations discussed included having a relatively small sample size, and concerns over the impact of participants’ subjective preference. The researchers discuss that some studies have shown that the effect of music on stress and anxiety depend on personal preference, and that this issue could also be valid for meditation according to participants’ preferences and abilities. Nevertheless, this study is one of the first to show that using a mindfulness app can help to reduce stress in certain populations, and that the mindfulness-based intervention was perceived as relatively easy and useful. Although participants felt the mindfulness intervention was easy and useful, the researchers point out that many participants declared that it was not easy to make time to do the exercises. This challenge of limited time seems to further indicate
an important cost-benefit trade-off, and a desire to have simple and relatively quick methods for stress management that are not only effective, but that individuals will actually use.

Finding quick and effective methods for managing stress may be especially important for a college-aged population, as a study by Cho, Quinlan, Park, and Noh (2014) explored the determinants of adoption of smartphone health apps among college students. They found subjective norms, health consciousness, health information orientation, and Internet health information use efficacy significantly impact the main components of the Technology Acceptance Model (TAM); namely perceived usefulness and perceived ease of use. Similarly, Ly et al. (2014) conducted a study which compared the effectiveness of two smartphone-delivered treatments in participants diagnosed with major depressive disorder. One of the treatments was based on behavioral activation (BA) and the other on mindfulness. Each treatment was administered as an 8-week long program. Their results indicated that the two interventions did not differ significantly from one another. However, for participants with higher severity of depression, the treatment based on BA was superior to the treatment based on mindfulness. Conversely, for participants with lower initial severity, the treatment based on mindfulness worked significantly better than the treatment based on BA (Ly et al., 2014).

Since the 8-week long mindfulness program showed similar efficacy as the BA group, there may be a potentially fruitful “sweet spot” or optimal treatment duration between the 3-week program described by Carissoli et al. (2015) and the 8-week program described by Ly et al. (2014), that could be a cost-effective way to impart the benefits of the mindfulness-based intervention while mitigating the costs that are associated with it (e.g., time cost, financial cost, accessibility issues, concerns of stigma, etc.). Therefore, inspired by this recommendation, our study utilized some of the key elements of mindfulness over a 4-week protocol.
At the orientation session, participants in the experimental group will have received a link from the researchers via email to download the mindfulness app. There was no financial cost associated with the app for the participant. Participants then independently followed a 4-week protocol for their respective interventions (requiring approximately 15 minutes per day; or approximately 90 minutes per week for the intervention group), and completed post-intervention measures and final paperwork at the end of their 4-weeks. The intervention group was instructed to complete 90 minutes of meditation/mindfulness practice per week using the Mindfulness App. The first week they were instructed to do only the “guided” exercises, and for the second/third/fourth weeks they are free to choose from either the “guided” and/or “non-guided” exercises. Adherence to this was assessed using the app’s built-in statistics function. Participants were instructed to call and/or email the student researcher if they have any questions or concerns with this process.

One of the underlying hypotheses for the study is that that mindfulness practices may help to improve resiliency to stressors (i.e., lessen the negative psychological impact of these factors), as well as help to produce a greater sense of agency for combatting and/or transforming these systemic factors (i.e., coping). To elaborate, mindfulness is thought to change physical structures/processes (e.g., nervous system response, brain development/neuroplasticity); psychological processes (e.g., appraisal of stressful stimulus/events, etc.); as well as behavioral processes (e.g., type of coping strategy, etc.). The rationale for this is that mindfulness is considered to be a qualitatively different phenomenon compared to some of the more frequently cited stress coping mechanisms of today’s generation of college students, such as listening to music, sleeping, socializing, and relaxing (Bland et al., 2012). Although mindfulness can be
relaxing, it is not solely a self-relaxation technique (Baer, 2003), but rather a form of mental training that facilitates more adaptive responding to stress (Bishop, 2002).
Chapter 3: Methodology

Participants

A convenience sample was used, recruiting both undergraduate and graduate students from a mid- to large-sized university in the northeastern United States. Participants were randomly assigned to either the intervention group or the control group using a random number generator.

Overall, 24 participants started the study, with a total of 21 participants completing the study, for an overall study attrition rate of 12.5%. Initially, 14 participants started the study in the intervention group, with 3 participants dropping out, leaving a final total of 11 participants in the intervention group, for an intervention group attrition rate of 21.4%. Additionally, 10 participants started the study in the control group, with all 10 control group participants completing the study, for a control group attrition rate of 0%. The study sample was comprised of 7 males (33.3%) and 14 females (66.7%), with 15 participants being undergraduate students (71.4%) and 6 participants being graduate students (28.6%). Participant’s ages ranged from 18-25 years of age (M=20.89, SD=2.18).

A total of 9 participants endorsed being psychology majors (42.9%), 4 endorsed being engineering majors (14.3%), and the remaining 8 included one participant each from a variety of majors including accounting, biological science, business, communications, pharmacy, media study, exercise science, and undeclared (approximately 5.3% each, respectively). Finally, the study sample included 10 participants who identified their ethnicity as Asian/Pacific Islander (47.6%), 10 participants who identified as Caucasian/White (47.6%), and 1 participant who identified as Hispanic (4.8%).

Measures
Mindfulness. To measure mindfulness, the 12-item Cognitive and Affective Mindfulness Scale–Revised (CAMS-R; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007) will be used to measure four aspects of mindfulness, including attention, awareness, acceptance, and present-focus. Previous psychometric evaluation of the CAMS-R found scores to be reliable and valid, demonstrating acceptable internal consistency (sample 1 $\alpha = .74$; sample 2 $\alpha = .77$; sample 3 $\alpha = .76$); as well as evidence of convergent and discriminant validity with concurrent measures of mindfulness, distress, well-being, emotion-regulation, and problem-solving approaches in three samples of university students (Feldman et al., 2007). Additionally, a recent outcome study found that the CAMS-R was sensitive to change following MBSR training (Greeson, et al., 2011). Higher scores indicate higher levels of mindfulness.

Psychological Stress (Perceived Stress Scale). To measure participant’s levels of psychological stress, the Perceived Stress Scale (PSS-10; Cohen, Kamarck, & Mermelstein, 1983) will be used. Overall, the 10-item PSS (PSS-10) reliability and internal validity have been reported as high, with $\alpha$ from .84 to .86 (Cohen, Kamarck, & Mermelstein, 1983), and is one of the most widely used psychological instruments for measuring the perception of stress (Cohen et al., 1983; Cohen & Williamson, 1988). In general, it is a measure of the degree to which situations in one’s life are appraised as stressful. Items were designed to tap how unpredictable, uncontrollable, and overloaded respondents find their lives (Cohen et al., 1983). The scale also includes a number of direct queries about current levels of experienced stress (Cohen et al., 1983). Participants responded on a 5-point scale ranging from 0 (never) to 4 (very often). Of the 10 items, 4 items were worded in a positive direction, so they were reverse-scored. The responses to the 10 items were then summed to create a total perceived stress score (0-40), with higher scores indicating greater psychological stress.
Physiological Stress (Heart Rate Variability). To measure participant’s levels of physiological stress, Heart Rate Variability (HRV) will be measured via smartphone using the ithlete Heart Rate Variability (HRV) App and ithlete finger sensor (designed by ithlete at a cost to the consumer of $8.99 and $69.99, respectively). There will be no financial cost associated with this measure for any of the participants. Although several autonomic activity measures are associated with acute or chronic stress including blood pressure, electro-dermal response, skin temperature, respiratory rate, heart rate and HRV (Oken, Chamine, & Wakeland, 2015), this study will use HRV due to its relative ease of measurement, as well as its time and financial cost-effectiveness.

Each HRV assessment will take 1 minute to administer using the smartphone. Participants will be assessed at the beginning of the study to attain a pre-intervention baseline measure of HRV and then at the end of the study to attain a post-intervention measure of HRV. Smartphone-enabled HRV monitors have been found to be an effective method for collecting HRV data for large-sample or naturalistic cardiac-related psychophysiological research (Heathers, 2013).

This particular tool was selected due to its balance of practicality and scientific foundation. Many parameters have been for measuring HRV over the last 30 years. They fall into three types: time domain, frequency domain, and entropy (chaos) measures. However, very few of these are suitable for use outside the laboratory by untrained users with limited time available for measurement. The ithlete HRV app uses RMSSD (Root Mean Square of the Successive Differences), a time domain parameter that correlates very highly with the more complex frequency domain measure HF (High Frequency), without requiring a breathing rate greater than 9 breaths per minute or stationarity of underlying heart rate (“myithlete,” 2015).
According to the designer’s website, the raw RMSSD measure has poor statistical properties, so they decided to apply natural Log (Ln) transformation, which allows common statistical measures such as standard deviation (SD) and coefficient of variation (CV) to be used. The resulting statistic is then automatically multiplied by 20 to place it on a more “meaningful” 100-point scale. The designers established that 1 minute is sufficient for a very good level of scientific validity whilst being short enough to maximize user compliance. Although just 30 seconds is sufficient for RMSSD from a signal processing perspective, the 1 minute measure of LnRMSSD was validated in a study by Esco and Flatt (2014), which reported an intra-class correlation of 0.98 (0.93, 0.99) and 0.0 bias (LoA 0.22) for the 1 minute measure compared to the criterion measure of 5 minutes.

**Stereotype Threat.** To measure stereotype threat (ST), two subscales from the Social Identities and Attitudes Scale (SIAS; Picho & Brown, 2011) will be used; gender stigma consciousness (GSC) and ethnicity stigma consciousness (ESC). Both the GSC and ESC subscales have five questions each. Examples of questions include “my gender affects how people treat me”, and “most people judge me on the basis of my ethnicity”. Response options to the items range from 1 (“strongly disagree”) to 7 (“strongly agree”). Exploratory and confirmatory factor analyses conducted with college students revealed that the overall scale, which constitutes six key ST moderators, possessed strong psychometric properties. A priori, a desirable alpha level of 0.8 was determined as acceptable for the subscales (Netemeyer, Bearden, & Sharma, 2003). Reliability estimates for the SIAS factors ranged from .81 to .95 (GSC scale=.88 and ESC=.85); and bivariate subscale correlations provided support for convergent and discriminant validity. The SIAS makes it possible to establish a baseline for measuring ST susceptibility and, subsequently, the impact of interventions attempting to reduce it.
Additionally, its use as a tool for identifying high-risk ST individuals might also be useful for mixed methods research seeking to understand contextual factors that exacerbate ST for these individuals and, importantly, how they respond to these environments (Picho & Brown, 2011). Higher scores indicate higher levels of stereotype threat.

**Coping Style (Brief COPE).** To measure coping style, the *Brief COPE* will be used. The Brief COPE (*Brief COPE;* Carver, 1997) is a modified version of the COPE Inventory designed to provide a streamlined assessment of coping that would allow for shortened administration time for researchers who were analyzing multiple variables within one sample population (Carver, 1997). It measures different coping responses, including those considered to be both adaptive and maladaptive. The Brief COPE reduces the questionnaire to 14 scales with two items per scale. The 14 scales include self-distraction (items 1 and 19), active coping (items 2 and 7), denial (items 3 and 8), substance use (items 4 and 11), use of emotional support (items 5 and 15), use of instrumental support (items 10 and 23), behavioral disengagement (items 6 and 16), venting (items 9 and 21), positive reframing (items 12 and 17), planning (items 14 and 25), humor (items 18 and 28), acceptance (items 20 and 24), religion (items 22 and 27), and self-blame (items 13 and 26).

Response options to the items range from 1 (I haven’t been doing this at all) to 4 (I’ve been doing this a lot). Higher scores indicate higher levels of respective coping style (i.e., active coping, denial, behavioral disengagement, etc.). The items can also be converted to a dispositional “coping style” format or a situational concurrent format, by changing verbs (Carver, 1997). Reliability analysis evidenced alpha levels ranging from $\alpha = .50$ to $\alpha = .90$. Results from analyses suggest that validity and reliability are similar to results from the original
COPE and that the Brief COPE is a good option for researchers who need a shortened measure of coping (Carver, 1997).

Nes and Segerstrom (2006) found that active coping, use of instrumental support, and planning could be categorized as problem approach coping responses; while the use of emotional support, venting, positive reframing, acceptance, and religion may be classified as emotion approach responses. Additionally, they found that only behavioral disengagement could be categorized as avoidance problem coping, and self-distraction, denial, and substance use may be classified as avoidance emotion coping responses. Finally, humor and self-blame could be considered emotion-focused strategies, but they are indistinguishable on the approach vs. avoidance dimension. Although potential differences in coping style will be explored, each of the 14 scales will be assessed separately for this study. And while a comparison of group differences in each of these scales can provide an insightful look into the utilization of differing coping methods, a recent study by Monzani et al. (2015) found that active coping was positively correlated to “goal progress” (R = .256, p < .001), while denial (R = -.272, p < .001), and behavioral disengagement (R = -.419, p < .001) were negatively correlated to “goal progress”. Therefore, these scales will be of primary interest for this study.

It is important to note, however, that both active coping and avoidant coping are both forms of “coping”, and although avoidant coping strategies are often negatively correlated to goal progress, there can be many benefits from engaging in things such as fantasy and distraction techniques. Additionally, it is important to consider the entire context of a given situation and associated strategy. For example, if an individual is well-rested and has attained eight hours of high-quality sleep yet chooses to sleep an additional four hours, it will likely be negatively correlated to “goal progress”, however, if they are tired and have only attained three hours of
sleep, then sleeping at that moment may be the single best thing they can do, and would likely be positively correlated to goal progress. Thus, active coping strategies (including both problem-focused and emotion focused) and avoidant coping strategies might both have their own advantages at certain times and in certain contexts, however, most of the research in this area seeks to assess and evaluate which styles are more “predominantly” used by individual, and how these forms of coping related to various outcomes.

**Qualitative measures (potential benefits/user experience).** In addition to quantitative measures, the users’ experience with the self-help intervention, especially in regard to difficulty and perceived usefulness of the intervention were assessed. To assess the level of difficulty and the perceived usefulness of the intervention, three items rated on a 5-point Likert scale were used. The question related to difficulty asked participants “how did you find the tasks required by the intervention?” (1 = “very difficult”, 5 = “very easy”). The questions related to usefulness asked “did you find the intervention useful?” and “would you suggest this type of practice for stress management?” (1 = “strongly disagree”, 5 = “strongly agree”).

Additionally, six open-ended questions were asked post-intervention to assess the role of diversity in mindfulness training. The open-ended questions asked participants to “Please discuss if and how this research on mindfulness assisted you in dealing with each of the following areas: 1) racial discrimination, 2) gender discrimination, 3) economic strain, 4) acculturation issues/immigration issues (i.e., adapting to the local culture), and 5) academic achievement”, and 6) “What, if anything, did you like about the intervention?” Based on participants’ responses to the open-ended questions, we explored whether any themes or patterns have emerged. Additionally, the open-ended questions helped to provide contextual information
for our research questions, as well as helping to provide specific examples of how the intervention may have impacted the various areas of participants’ lives.

Study Design

A controlled pragmatic trial was used for the current study. Controlled pragmatic trials are typically designed to test the effectiveness of interventions in real life in order to maximize their applicability and generalizability (Patsopoulos, 2011). As a pilot study, we will utilize our small scale preliminary study to evaluate factors such as feasibility, time, cost, potential adverse events, and effect size in an attempt to predict an appropriate sample size and improve upon the study design prior to performance of any full-scale or derivative research projects.

The brief self-help protocol using the mindfulness training app intervention (treatment group) was compared with a non-treatment control group. The rationale for this is that mindfulness is considered to be a qualitatively different phenomenon compared to some of the more frequently cited stress coping mechanisms of today’s generation of college students, such as listening to music, sleeping, socializing, and relaxing (Bland et al., 2012). Although mindfulness can be relaxing, it is not solely a self-relaxation technique (Baer, 2003), but rather a form of mental training that facilitates more adaptive responding to stress (Bishop, 2002). In other words, both relaxation training (diaphragmatic breathing, progressive muscle relaxation, guided imagery, to name a few) and mindfulness training can be effective for managing stress, however, mindfulness is an approach which may also be used to increase awareness and respond skillfully to mental processes that contribute to emotional distress and maladaptive behavior (Bishop et al., 2004). Thus, while the main intention of relaxation training is to promote greater relaxation (i.e., lowering autonomic arousal, decreasing muscle tension, lowering blood pressure,
balancing nervous system and/or improving efficiency of parasympathetic response, etc.), mindfulness training “may” include these same areas as an indirect consequence, though with the primary intention being to increase awareness, and to improve one’s ability to respond more skillfully. Clinical hypnosis is another example where relaxation may be either a direct, intended consequence of the intervention (perhaps one of many intended consequences), but in other cases could merely be a byproduct (or indirect consequence) of the intervention. (For a more detailed description on the various components of mindfulness, including purpose/intention, rationale, proposed mechanisms of action, etc., please refer to our overview of mindfulness in chapter 2).

The two groups (treatment and control) were compared on pre- and post-intervention measures of mindfulness, using the Cognitive and Affective Mindfulness Scale–Revised (CAMS-R; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007); psychological stress, using the Perceived Stress Scale (PSS-10; Cohen, Kamarck, & Mermelstein, 1983); physiological stress using a Heart Rate Variability measure; stereotype threat (gender stigma consciousness and ethnicity stigma consciousness), using the Social Identities and Attitudes Scale (SIAS; Picho & Brown, 2011); and coping style, using the Brief COPE (Brief COPE; Carver, 1997).

**Procedures**

Participants were randomly assigned to either the intervention group or the control group using a random number generator. Participants in both groups were given a short orientation which included a basic introduction and overview of their respective interventions (approximately 10 minutes), as well as completion of any necessary paperwork (e.g., consent forms, contracts, etc.) and baseline measures (approximately 20 minutes). Additionally, participants in the experimental group either received a link from the researcher via email to download the mindfulness app, or downloaded the app during this initial appointment. There
was no financial cost associated with the app for the participant. Participants then independently followed a 4-week protocol for their respective interventions (requiring approximately 15 minutes per day; or approximately 90 minutes per week for the intervention group; and no additional work for the control group), and completed post-intervention measures and final paperwork at the end of their 4-weeks. The intervention group was instructed to complete 90 minutes of meditation/mindfulness practice per week using the Mindfulness App. The first week they were instructed to do only the “guided” exercises, and for the second/third/fourth weeks they were free to choose from either the “guided” and/or “non-guided” exercises. Adherence to this was assessed using the app’s built-in statistics function. Participants were instructed to call and/or email the student researcher if they have any questions or concerns with this process.

**Data Analysis**

The two groups were compared at baseline to determine if there are any significant differences for any of the factors. Next, a one-way analysis of covariance (ANCOVA) was used to assess for any post-test group differences for mindfulness, psychological stress, physiological stress, stereotype threat (gender stigma consciousness and ethnicity stigma consciousness), and coping style (active coping, denial, and behavioral disengagement), using pre-test scores on each measure as a covariate.

Finally, in addition to quantitative measures, the users’ experience with the mindfulness intervention was assessed post-intervention, particularly in regard to difficulty and perceived usefulness of the intervention. To assess the level of difficulty and the perceived usefulness of the intervention, three items rated on a 5-point Likert scale were used. The question related to difficulty asked participants “how did you find the tasks required by the intervention?” (1 = “very difficult”, 5 = “very easy”). The questions related to usefulness asked “did you find the
intervention useful?” and “would you suggest this type of practice for stress management?” (1 = “strongly disagree”, 5 = “strongly agree”). Finally, six open-ended questions were asked post-intervention to assess the role of diversity in mindfulness training. The open-ended questions asked participants to “Please discuss if and how this research on mindfulness assisted you in dealing with each of the following areas: 1) racial discrimination, 2) gender discrimination, 3) economic strain, 4) acculturation issues/immigration issues (i.e., adapting to the local culture; including school, campus, city, state, country), and 5) academic achievement”, and 6) “What, if anything, did you like about the intervention?”. Using participants’ responses to the open-ended questions, we explored whether any themes or patterns had emerged. This was done by simply analyzing participants’ verbatim responses for particular themes (e.g., the app helped distract me; take my mind off; or escape from my worries). The open-ended questions helped to provide contextual information for our research questions, as well as helping to provide specific examples of how the intervention may have impacted the various areas of participants’ lives.
Chapter 4: Results

Descriptive Statistics

The study sample included a total of 21 participants, with 11 participants in the intervention group and 10 participants in the control group. As a pilot study, the 21 participants resulted in an adequate sample size for the primary intentions of the study, however, the relatively small sample size can have an impact on statistical power, and thus it is noted as an expected limitation of the study. As such, an analysis of covariance (ANCOVA) was used to test our six study hypotheses as it is considered superior to ANOVA in regard to increased statistical power and control. The use of pre-test measures as covariates is to reduce the probability of a type II error, and to better control for initial group differences. Since the probability of a type II error is inversely related to statistical power, the ANCOVA will be more powerful than its ANOVA counterpart.

Preliminary Analyses

Testing Study Hypotheses

Testing Hypothesis #1

1. Students who utilize the MF training app will have higher ratings of MF as compared to students who do not.

A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had higher ratings of MF as compared to students who did not (i.e. vs. the control group), using pre-test MF scores as a covariate. Levene’s test and normality checks were carried
out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10 participants in the control group. Results indicated that there was not a significant difference in MF scores \([F(1,18)=2.179, p=0.157]\) between the two groups. See Table 4.

Although not statistically significant, students who utilized the MF app did have a higher overall increase in MF scores, than did the control group, with the intervention group’s post-test MF scores increasing 1.91 points from their pre-test MF scores; indicating a 5.76% increase in MF score for the intervention group. Comparatively, the control group’s post-test MF scores increased only 0.10 points from their pre-test MF scores; indicating a 0.33% increase in MF score for the control group. See Tables 2.

Table 1

<table>
<thead>
<tr>
<th>Tests of Normality</th>
<th>Kolmogorov-Smirnov</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group</td>
<td>Statistic df Sig.</td>
</tr>
<tr>
<td>Mindfulness (pre)</td>
<td>1</td>
<td>.162 11 .200*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>.136 10 .200*</td>
</tr>
<tr>
<td>Mindfulness (post)</td>
<td>1</td>
<td>.243 11 .070</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>.127 10 .200*</td>
</tr>
</tbody>
</table>

* This is a lower bound of the true significance.

a. Lilliefors Significance Correction
Table 2

**Descriptive Statistics**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mindfulness (pre)</th>
<th>Mindfulness (post)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean</td>
<td>33.18</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>5.154</td>
</tr>
<tr>
<td>2</td>
<td>Mean</td>
<td>30.50</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>5.603</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>31.90</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>5.412</td>
</tr>
</tbody>
</table>

Table 3

**Levene's Test of Equality of Error Variances**

<table>
<thead>
<tr>
<th>Dependent Variable: Mindfulness (post)</th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.319</td>
<td>1</td>
<td>19</td>
<td>.579</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Mindfulnesspre + Group
Table 4

Tests of Between-Subjects Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>348.452(^a)</td>
<td>2</td>
<td>174.226</td>
<td>10.577</td>
<td>.001</td>
<td>.540</td>
<td>21.154</td>
<td>.973</td>
</tr>
<tr>
<td>Intercept</td>
<td>71.574</td>
<td>1</td>
<td>71.574</td>
<td>4.345</td>
<td>.052</td>
<td>.194</td>
<td>4.345</td>
<td>.505</td>
</tr>
<tr>
<td>Group</td>
<td>35.889</td>
<td>1</td>
<td>35.889</td>
<td>2.179</td>
<td>.157</td>
<td>.108</td>
<td>2.179</td>
<td>.287</td>
</tr>
<tr>
<td>Error</td>
<td>296.500</td>
<td>18</td>
<td>16.472</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>23448.000</td>
<td>20</td>
<td>1172.400</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) R Squared = .540 (Adjusted R Squared = .489)
\(^b\) Computed using alpha = .05

Testing Hypothesis #2

2. Students who utilize the MF training app will have lower ratings of perceived (psychological) stress as compared to students who do not.

A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had lower ratings of perceived stress as compared to students who did not (i.e. vs. the control group), using pre-test perceived stress scores as a covariate. Levene’s test and normality checks were carried out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10 participants...
in the control group. Results indicated that there was not a significant difference in perceived stress scores \(F(1,18)=.563, p=.463\) between the two groups. See Table 8.

Although not statistically significant, students who utilized the MF app did have a larger overall decrease in perceived stress, than did the control group, with the intervention group’s post-test perceived stress scores (M=18.00, SD=8.11) decreasing 1.82 points from their pre-test perceived stress scores (M=19.82, SD=5.62); indicating a 9.18% decrease in perceived stress score for the intervention group. Comparatively, the control group’s post-test perceived stress scores (M=21.30, SD=5.50) decreased 1.20 points from their pre-test perceived stress scores (M=22.50, SD=6.35); indicating a 5.33% decrease in perceived stress score for the control group.

Table 5

\[\text{Table 5} \]

\textit{Descriptive Statistics}

<table>
<thead>
<tr>
<th>Group</th>
<th>PSS (pre)</th>
<th>PSS (post)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean 19.82</td>
<td>18.00</td>
</tr>
<tr>
<td></td>
<td>N 11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 5.618</td>
<td>8.112</td>
</tr>
<tr>
<td>2</td>
<td>Mean 22.50</td>
<td>21.30</td>
</tr>
<tr>
<td></td>
<td>N 10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 6.346</td>
<td>5.498</td>
</tr>
<tr>
<td>Total</td>
<td>Mean 21.10</td>
<td>19.57</td>
</tr>
<tr>
<td></td>
<td>N 21</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 5.983</td>
<td>7.025</td>
</tr>
</tbody>
</table>
Table 6

Tests of Normality

<table>
<thead>
<tr>
<th>Group</th>
<th>Kolmogorov-Smirnov&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statistic</td>
<td>df</td>
</tr>
<tr>
<td>PSS (pre)</td>
<td>1</td>
<td>.149</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>.209</td>
</tr>
<tr>
<td>PSS (post)</td>
<td>1</td>
<td>.130</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>.178</td>
</tr>
</tbody>
</table>

* This is a lower bound of the true significance.

<sup>a</sup> Lilliefors Significance Correction

Table 7

Levene's Test of Equality of Error Variances<sup>a</sup>

<table>
<thead>
<tr>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.362</td>
<td>1</td>
<td>19</td>
<td>.082</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

<sup>a</sup> Design: Intercept + PSSpre + Group
**Table 8**

*Tests of Between-Subjects Effects*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>152.555</td>
<td>2</td>
<td>76.277</td>
<td>1.645</td>
<td>.221</td>
<td>.155</td>
<td>3.290</td>
<td>.301</td>
</tr>
<tr>
<td>Intercept</td>
<td>193.669</td>
<td>1</td>
<td>193.669</td>
<td>4.177</td>
<td>.056</td>
<td>.188</td>
<td>4.177</td>
<td>.490</td>
</tr>
<tr>
<td>PSSpre</td>
<td>95.512</td>
<td>1</td>
<td>95.512</td>
<td>2.060</td>
<td>.168</td>
<td>.103</td>
<td>2.060</td>
<td>.274</td>
</tr>
<tr>
<td>Group</td>
<td>26.104</td>
<td>1</td>
<td>26.104</td>
<td>.563</td>
<td>.463</td>
<td>.030</td>
<td>.563</td>
<td>.110</td>
</tr>
<tr>
<td>Error</td>
<td>834.588</td>
<td>18</td>
<td>46.366</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Total</td>
<td>9031.000</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Corrected Total 987.143 20

a. R Squared = .155 (Adjusted R Squared = .061)
b. Computed using alpha = .05

**Testing Hypothesis #3**

3. Students who utilize the MF training app will have lower ratings of physiological stress (i.e., higher HRV) as compared to students who do not.

A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had lower ratings of physiological stress as compared to students who did not (i.e. vs. the control group), using pre-test physiological stress scores (HRV) as a covariate. Levene’s test and normality checks were carried out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10
participants in the control group. Results indicated that there was a significant difference in physiological stress scores $[F(1,18)=5.597, p=.029]$ between the two groups (See Table 12). Partial eta squared was .237, which based on Cohen’s (1988) convention for effect size indicates a large effect size, and means that approximately 23.7% of the variance in participants post-test physiological scores (HRV) is explained by the participant’s group (intervention vs. control).

Students who utilized the MF app had a larger overall decrease in physiological stress scores (i.e., a larger overall increase in HRV), than did the control group, with the intervention group’s post-test HRV scores increasing 2.28 points from their pre-test HRV scores; indicating a 2.91% increase in HRV score for the intervention group. Comparatively, the control group’s post-test HRV scores decreased 4.80 points from their pre-test HRV scores; indicating a 6.01% decrease in HRV score for the control group.

Table 9

<table>
<thead>
<tr>
<th>Tests of Normality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Group</td>
</tr>
<tr>
<td>Kolmogorov-Smirnov$^a$</td>
</tr>
<tr>
<td>Statistic</td>
</tr>
<tr>
<td>HRV</td>
</tr>
<tr>
<td>(pre)</td>
</tr>
<tr>
<td>HRV</td>
</tr>
<tr>
<td>(post)</td>
</tr>
</tbody>
</table>

$^a$. This is a lower bound of the true significance.

a. Lilliefors Significance Correction
Table 10

**Descriptive Statistics**

<table>
<thead>
<tr>
<th>Group</th>
<th>HRV (pre)</th>
<th>HRV (post)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean 78.45</td>
<td>80.73</td>
</tr>
<tr>
<td></td>
<td>N 11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 13.118</td>
<td>8.912</td>
</tr>
<tr>
<td>2</td>
<td>Mean 79.90</td>
<td>75.10</td>
</tr>
<tr>
<td></td>
<td>N 10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 11.130</td>
<td>15.624</td>
</tr>
<tr>
<td>Total</td>
<td>Mean 79.14</td>
<td>78.05</td>
</tr>
<tr>
<td></td>
<td>N 21</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 11.930</td>
<td>12.564</td>
</tr>
</tbody>
</table>

Table 11

*Levene's Test of Equality of Error Variances*

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>.814</td>
<td>1</td>
<td>19</td>
<td>.378</td>
<td></td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + HRV pre + Group
Table 12

Tests of Between-Subjects Effects
Dependent Variable: HRV (post)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>2358.458\textsuperscript{a}</td>
<td>2</td>
<td>1179.229</td>
<td>26.583</td>
<td>.000</td>
<td>.747</td>
<td>53.165</td>
<td>1.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>30.431</td>
<td>1</td>
<td>30.431</td>
<td>.686</td>
<td>.418</td>
<td>.037</td>
<td>.686</td>
<td>.123</td>
</tr>
<tr>
<td>HRVpre</td>
<td>2192.587</td>
<td>1</td>
<td>2192.587</td>
<td>49.426</td>
<td>.000</td>
<td>.733</td>
<td>49.426</td>
<td>1.000</td>
</tr>
<tr>
<td>Group</td>
<td>248.305</td>
<td>1</td>
<td>248.305</td>
<td>5.597</td>
<td>.029</td>
<td>.237</td>
<td>5.597</td>
<td>.610</td>
</tr>
<tr>
<td>Error</td>
<td>798.494</td>
<td>18</td>
<td>44.361</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>131077.000</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>3156.952</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a} R Squared = .747 (Adjusted R Squared = .719)
\textsuperscript{b} Computed using alpha = .05

**Testing Hypothesis #4**

4. Students who utilize the MF training app will have lower ratings of stereotype threat (gender stigma consciousness) as compared to students who do not.

A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had lower ratings of stereotype threat (gender stigma consciousness) as compared to students who did not (i.e. vs. the control group), using pre-test gender stigma consciousness scores (GSC) as a covariate. Levene’s test and normality checks were carried out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10 participants in the control group. Results indicated
that there was not a significant difference in gender stigma consciousness scores \([F(1,18)=.692, p=.416]\) between the two groups. See Table 15.

Although not statistically significant, students who utilized the MF app had a slight overall increase in gender stigma consciousness (GSC) scores than did the control group, with the intervention group’s post-test GSC scores increasing 0.0 points (unchanged) from their pre-test GSC scores; indicating a 0.0% increase in GSC score for the intervention group. Comparatively, the control group’s post-test GSC scores increased 1.4 points from their pre-test GSC scores; indicating a 6.57% increase in GSC score for the control group.

Table 13

<table>
<thead>
<tr>
<th>Group</th>
<th>GSC (pre)</th>
<th>GSC (post)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean 20.36</td>
<td>20.36</td>
</tr>
<tr>
<td></td>
<td>N 11</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 9.384</td>
<td>7.749</td>
</tr>
<tr>
<td>2</td>
<td>Mean 21.30</td>
<td>22.70</td>
</tr>
<tr>
<td></td>
<td>N 10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 7.747</td>
<td>7.804</td>
</tr>
<tr>
<td>Total</td>
<td>Mean 20.81</td>
<td>21.48</td>
</tr>
<tr>
<td></td>
<td>N 21</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation 8.442</td>
<td>7.672</td>
</tr>
</tbody>
</table>
Table 14

*Levene's Test of Equality of Error Variances*<sup>a</sup>

<table>
<thead>
<tr>
<th>Dependent Variable: GSC (post)</th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.918</td>
<td>1</td>
<td>19</td>
<td>.182</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + GSCpre + Group

Table 15

*Tests of Between-Subjects Effects*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III</th>
<th>Partial</th>
<th>Corrected</th>
<th>Power&lt;sub&gt;b&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sum of Squares</td>
<td>Mean Square</td>
<td>F</td>
<td>Sig.</td>
</tr>
<tr>
<td></td>
<td>df</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>2</td>
<td>104.312</td>
<td>5.130</td>
<td>.036</td>
</tr>
<tr>
<td>GSCpre</td>
<td>1</td>
<td>782.641</td>
<td>38.490</td>
<td>.000</td>
</tr>
<tr>
<td>Group</td>
<td>1</td>
<td>14.066</td>
<td>.692</td>
<td>.416</td>
</tr>
<tr>
<td>Error</td>
<td>18</td>
<td>366.005</td>
<td>20.334</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>10863.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>20</td>
<td>1177.238</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .689 (Adjusted R Squared = .655)
b. Computed using alpha = .05

*Testing Hypothesis #5*

5. Students who utilize the MF training app will have lower ratings of stereotype threat (ethnicity stigma consciousness) as compared to student who do not.
A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had lower ratings of stereotype threat (ethnicity stigma consciousness) as compared to students who did not (i.e. vs. the control group), using pre-test ethnicity stigma consciousness scores (ESC) as a covariate. Levene’s test and normality checks were carried out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10 participants in the control group. Results indicated that there was not a significant difference in ethnicity stigma consciousness scores \[F(1,18)=1.78, \ p=.199\] between the two groups. See Table 18.

Although not statistically significant, students who utilized the MF app had a higher overall decrease in ethnicity stigma consciousness (ESC) scores than did the control group, with the intervention group’s post-test ESC scores decreasing 1.37 points from their pre-test ESC scores; indicating a 7.69% decrease in ESC score for the intervention group. Comparatively, the control group’s post-test ESC scores increased 0.4 points from their pre-test ESC scores; indicating a 2.19% increase in ESC score for the control group.
Table 16

<table>
<thead>
<tr>
<th>Group</th>
<th>ESC (pre)</th>
<th>ESC (post)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>17.82</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>9.683</td>
</tr>
<tr>
<td>2</td>
<td>Mean</td>
<td>18.30</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>4.596</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>18.05</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>7.513</td>
</tr>
</tbody>
</table>

Table 17

Levene's Test of Equality of Error Variances

<table>
<thead>
<tr>
<th>Dependent Variable: ESC (post)</th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.474</td>
<td>1</td>
<td>19</td>
<td>.500</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + ESCpre + Group
Table 18

Tests of Between-Subjects Effects
Dependent Variable: ESC (post)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>817.965a</td>
<td>408.982</td>
<td>41.064</td>
<td>.000</td>
<td>.820</td>
<td>82.128</td>
<td>1.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>17.780</td>
<td>17.780</td>
<td>1.785</td>
<td>.198</td>
<td>.090</td>
<td>1.782</td>
<td>.244</td>
</tr>
<tr>
<td>ESCpre</td>
<td>791.554</td>
<td>791.554</td>
<td>79.476</td>
<td>.000</td>
<td>.815</td>
<td>79.476</td>
<td>1.000</td>
</tr>
<tr>
<td>Group</td>
<td>17.749</td>
<td>17.749</td>
<td>1.782</td>
<td>.199</td>
<td>.090</td>
<td>1.782</td>
<td>.244</td>
</tr>
<tr>
<td>Error</td>
<td>179.273</td>
<td>9.960</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7446.000</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>997.238</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .820 (Adjusted R Squared = .800)
b. Computed using alpha = .05

Testing Hypothesis #6

6. Students who utilize the MF training app will have increased positive coping styles (i.e. higher active coping; lower denial and behavioral disengagement) as compared to students who do not.

Three separate one-way ANCOVAs were conducted to assess whether students who utilized the MF training app had higher active coping scores and lower denial and lower behavioral disengagement scores as compared to students who do not (i.e., vs. the control group). Overall, the results indicated that there were no significant differences between the two groups for any of the three coping styles.

Active Coping
A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had higher active coping as compared to students who did not (i.e. vs. the control group), using pre-test active coping scores as a covariate. Levene’s test and normality checks were carried out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10 participants in the control group. Results indicated that there was not a significant difference in active coping scores [F(1,18)=.096, p=.760] between the two groups. See Table 21.

Although not statistically significant, contrary to our hypothesis, students who utilized the MF app had a lower overall increase in active coping scores than did the control group, with the intervention group’s post-test active coping scores increasing 0.09 points from their pre-test active scores; indicating a 1.29% increase in active coping score for the intervention group. Comparatively, the control group’s post-test active coping scores increased 0.2 points from their pre-test active coping scores; indicating a 3.08% increase in active coping score for the control group.
Table 19

**Descriptive Statistics**

<table>
<thead>
<tr>
<th>Group</th>
<th>Active Coping (pre)</th>
<th>Active Coping (post)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>7.00</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1.183</td>
</tr>
<tr>
<td>1</td>
<td>Mean</td>
<td>6.50</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.972</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>6.76</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1.091</td>
</tr>
</tbody>
</table>

Table 20

*Levene's Test of Equality of Error Variances*

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>.032</td>
<td>1</td>
<td>19</td>
<td></td>
<td>.861</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + ActiveCopingpre + Group
Table 21

Tests of Between-Subjects Effects
Dependent Variable: Active Coping (post)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>3.300</td>
<td>2</td>
<td>1.650</td>
<td>.639</td>
<td>.540</td>
<td>.066</td>
<td>1.277</td>
<td>.040</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>10.412</td>
<td>1</td>
<td>10.412</td>
<td>4.029</td>
<td>.060</td>
<td>.183</td>
<td>4.029</td>
<td>.227</td>
<td></td>
</tr>
<tr>
<td>ActiveCopingpre</td>
<td>2.500</td>
<td>1</td>
<td>2.500</td>
<td>.968</td>
<td>.338</td>
<td>.051</td>
<td>.968</td>
<td>.047</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>.249</td>
<td>1</td>
<td>.249</td>
<td>.096</td>
<td>.760</td>
<td>.005</td>
<td>.096</td>
<td>.013</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>46.509</td>
<td>18</td>
<td>2.584</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Corrected</td>
<td>1051.000</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Corrected</td>
<td>49.810</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .066 (Adjusted R Squared = -.037)
b. Computed using alpha = .01

Denial

A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had lower denial scores as compared to students who did not (i.e. vs. the control group), using pre-test denial scores as a covariate. Levene’s test and normality checks were carried out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10 participants in the control group. Results indicated that there was not a significant difference in denial scores \([F(1,18)=.135, p=.717]\) between the two groups. See Table 24.

Although not statistically significant, students who utilized the MF app had a lower overall increase in denial scores than did the control group, with the intervention group’s post-
test denial scores increasing 0.37 points from their pre-test denial scores; indicating a 15.68% increase in denial score for the intervention group. Comparatively, the control group’s post-test denial scores (increased 0.5 points from their pre-test denial scores; indicating a 20.83% increase in denial score for the control group.

Table 22

<table>
<thead>
<tr>
<th>Group</th>
<th>Denial (pre)</th>
<th>Denial (post)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean</td>
<td>2.36</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>.505</td>
</tr>
<tr>
<td>2</td>
<td>Mean</td>
<td>2.40</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Std. Deviation</td>
<td>1.265</td>
</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>2.38</td>
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<td></td>
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<td></td>
<td>Std. Deviation</td>
<td>.921</td>
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</tbody>
</table>

Table 23

_Levene's Test of Equality of Error Variances_

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>.111</td>
<td>1</td>
<td>19</td>
<td>.742</td>
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</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Denialpre + Group
Table 24

Tests of Between-Subjects Effects
Dependent Variable: Denial (post)

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Powerb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
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<td>3.974</td>
<td>4.679</td>
<td>.023</td>
<td>.342</td>
<td>9.357</td>
<td>.432</td>
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<td>Intercept</td>
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<td>3.755</td>
<td>4.421</td>
<td>.050</td>
<td>.197</td>
<td>4.421</td>
<td>.254</td>
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<tr>
<td>Denialpre</td>
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<td>1</td>
<td>7.792</td>
<td>9.173</td>
<td>.007</td>
<td>.338</td>
<td>9.173</td>
<td>.569</td>
</tr>
<tr>
<td>Group</td>
<td>.115</td>
<td>1</td>
<td>.115</td>
<td>.135</td>
<td>.717</td>
<td>.007</td>
<td>.135</td>
<td>.014</td>
</tr>
<tr>
<td>Error</td>
<td>15.290</td>
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<td>.849</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
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<td>Corrected Total</td>
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</table>

a. R Squared = .342 (Adjusted R Squared = .269)
b. Computed using alpha = .01

Behavioral Disengagement

A one-way ANCOVA was conducted to compare whether students who utilized the MF training app had lower behavioral disengagement scores as compared to students who did not (i.e. vs. the control group), using pre-test behavioral disengagement scores as a covariate. Levene’s test and normality checks were carried out and the assumptions met (homogeneity of variance; random independent samples; relationship between the dependent variable and the covariate is linear; homogeneity of regression slopes; covariate, pre-test score, is independent of the treatment effects). Our sample size included 11 participants in the intervention group and 10 participants in the control group. Results indicated that there was not a significant difference in behavioral disengagement scores [F(1,18)=.034, p=.856] between the two groups. See Table 27.
Although not statistically significant, students who utilized the MF app had a lower overall increase in behavioral disengagement scores than did the control group, with the intervention group’s post-test behavioral disengagement scores increasing 0.09 points from their pre-test behavioral disengagement scores; indicating a 3.09% increase in behavioral disengagement score for the intervention group. Comparatively, the control group’s post-test behavioral disengagement scores increased 0.5 points from their pre-test behavioral disengagement scores; indicating a 19.23% increase in behavioral disengagement score for the control group.

Table 25

Descriptive Statistics

<table>
<thead>
<tr>
<th>Group</th>
<th>Beh. Dis. (pre)</th>
<th>Beh. Dis. (post)</th>
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<tr>
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<td>Mean</td>
<td>2.60</td>
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<td></td>
<td>Std. Deviation</td>
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</tr>
<tr>
<td>Total</td>
<td>Mean</td>
<td>2.76</td>
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<tr>
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<td></td>
<td>Std. Deviation</td>
<td>.995</td>
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</table>
Table 26

*Levene's Test of Equality of Error Variances*\(^a\)

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Beh. Dis. (post)</th>
</tr>
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<tbody>
<tr>
<td><strong>F</strong></td>
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<tr>
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Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

\(a\) Design: Intercept + Beh.Dis.pre + Group

Table 27

*Tests of Between-Subjects Effects*

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Beh. Dis. (post)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
<th>Noncent. Parameter</th>
<th>Observed Power(^b)</th>
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</thead>
<tbody>
<tr>
<td>Corrected Model</td>
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<td>.030</td>
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<td>.982</td>
<td>.002</td>
<td>.035</td>
</tr>
<tr>
<td>Intercept</td>
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<td>20.327</td>
<td>20.327</td>
<td>11.844</td>
<td>.003</td>
<td>11.844</td>
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<td>Beh.Dis.pre</td>
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<td>.005</td>
<td>.945</td>
<td>.005</td>
<td>.005</td>
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<tr>
<td>Group</td>
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<td>.058</td>
<td>.034</td>
<td>.856</td>
<td>.002</td>
<td>.034</td>
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<td>Error</td>
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<td>30.892</td>
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<td>1.716</td>
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</tbody>
</table>

\(a\) R Squared = .002 (Adjusted R Squared = -.109)

\(b\) Computed using alpha = .01

*Post-Intervention Debriefing Questions (Difficulty/Usefulness)*

All participants in the intervention group (\(N=11\)) completed post-intervention debriefing questions regarding the difficulty and usefulness of the intervention.
Q1. How did you find the task required by the intervention? (Difficulty)

For question #1, “How did you find the task required by the intervention?” (1 = “very difficult”, 5 = “very easy”), the mean response was 4.45 (SD=.688). None of the participants rated the tasks as either “very difficult” or “difficult”; 1 participant rated it “neutral”; 4 rated it as “easy” and 6 rated it as “very easy”. Overall, 10 of the 11 participants (90.9%) rated the tasks required by the intervention as being either “easy” or “very easy”. See Tables 28 and 29.

Q2. Did you find the intervention useful? (Usefulness)

For question #2, “Did you find the intervention useful?” (1 = “strongly disagree”, 5 = “strongly agree”), the mean response was 4.18 (SD=.874). None of the participants endorsed “strongly disagree”; 1 of the participants endorsed “disagree”; 0 endorsed “neither agree nor disagree; 6 endorsed “agree”; while 4 endorsed “strongly agree”. Overall, 10 of the 11 participants (90.9%) endorsed either “agree” or “strongly agree” that they found the intervention useful. See Tables 28 and 30.

Q3. Would you suggest this type of practice for stress? (Usefulness)

For question #3, “Would you suggest this type of practice for stress?” (1 = “strongly disagree”, 5 = “strongly agree”), the mean response was 4.18 (SD=.751). None of the participants endorsed “strongly disagree”; none of the participants endorsed “disagree”; 2 endorsed “neither agree nor disagree; 5 endorsed “agree”; while 4 endorsed “strongly agree”. Overall, 9 of the 11 participants (81.8%) endorsed either “agree” or “strongly agree” that they would suggest this type of practice for stress management; while none of the participants (0%)
endorsed “strongly disagree” or “disagree” concerning whether they would suggest this type of practice for stress management. See Tables 28 and 31.

Table 28

<table>
<thead>
<tr>
<th>Report</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4.45</td>
<td>4.18</td>
<td>4.18</td>
</tr>
<tr>
<td>N</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>.688</td>
<td>.874</td>
<td>.751</td>
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</table>

Table 29

<table>
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<th>Q1</th>
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<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
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<tr>
<td></td>
<td>1 Valid</td>
<td>3</td>
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<td>9.1</td>
</tr>
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<td></td>
<td>Total</td>
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2 Missing System | 10 | 100.0 |

Table 30

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<tr>
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<th>Group</th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
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<tr>
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<tr>
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<td>Total</td>
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<td>100.0</td>
<td>100.0</td>
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</table>

2 Missing System | 10 | 100.0 |
Table 31

<table>
<thead>
<tr>
<th>Group</th>
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<th>Percent</th>
<th>Cumulative Percent</th>
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<tr>
<td></td>
<td>Total</td>
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<td>100.0</td>
<td>100.0</td>
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</table>

<table>
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<tr>
<th>Group</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Missing</td>
<td>10</td>
</tr>
</tbody>
</table>

Post-Intervention Debriefing Questions (Role of Diversity in Mindfulness Training)

Raw data (verbatim responses) from the post-intervention debriefing questions follows. Further analysis and integration of the participants’ responses will be provided in the discussion section:

Q4. Racial discrimination (if applicable)

“Meditation gave inner peace. Made my mind have control of my emotions. Not being affected by others’ comments.”

“I became more aware/accepting of this.”

“I feel more confident to meet other people.”

Q5. Gender discrimination (if applicable)

“Meditation gave inner peace. Made my mind have control of my emotions. Not being affected by others’ comments.”

“I have been ignoring or may be trying to cope with gender discrimination.”
“I became more aware/accepting of this.”

Q6. Economic strain (if applicable)

“Cope up and try to find a better/alternative ways to manage it.”

“It assisted my issues with being able to pay tuition by reminding me that I control myself and that is all I have control over.”

“I used to worry a lot about this problem, the research helped me reduce my tension a little bit.”

“Using the app during high moments of stress helped distract my mind from this.”

“I became more aware/accepting of this.”

“It did not decrease my economic strain, possibly because of my situation.”

Q7. Acculturation issues (i.e., adapting/immigrating to the local culture—school, campus, city, state, country) (if applicable)

“Helped me cope up while relocating to the (a) new country.”

“It took my mind off of wishing I was home so often, but also allowed me to understand that I should be focusing on why I am here (at school).”

“Helps to (for) adapting.”

Q8. Academic achievement (if applicable)

“It helped me achieve my academic/studies requirements. Focus more. Perform better.”

“The app helped me to stay calm and focused when it felt like I had a lot of assignments/exams.”

“App forces you to slow down for a specific time every day; good to escape from academic stress.”
“It has improved my ability to focus on assignments. It has also helped to improve my bad procrastination habits.”

“I get up in the morning easily these days as opposed to earlier (previous) times.”

“Moderate”

“Completing my assignments for my classes has become less stressful and I find myself more interested in my studies. Going to class has become more enjoyable overall.”

“Using the app during times of academic stress would most likely help the most.”

“I was able to relax more/study better.”

“Helps.”

“I listen to it at night and fall asleep to the sound of it. It makes me feel relaxed.”

Q9. What (if anything) did you like about the intervention (if applicable)


“I really liked the guided meditations in the app. I used the app whenever I started to feel stressed/overwhelmed and it helped me to relax and put things into perspective.”

“App put pressure on me. I had busy days and it was sometimes hard to find time for it and to really meditate and not drift away with sounds.”

“The meditation is kind of monotonous and the voice robotic/mechanical.”

“Maybe a group that meditates together with me would be more helpful.”

“App was easy, no technical problems, you can do it everywhere.”

“I liked that, for a set amount of time, I was able to ignore everything about my surroundings and really listen to and feel my body. The silent meditations allowed me to explore thoughts, feelings, and sensations more precisely and thoroughly.”
“I like the guided meditations the most.”

“Easy and at times, very useful in reducing stress.”

“I enjoyed the ease access, being able to pull out my phone on a whim for guided meditation. In addition, the guided voice was helpful for keeping me focused on the session and the tracking of my progress motivated me to engage in mindfulness more frequently. The intervention was especially helpful for late night restlessness and I would often do an exercise shortly before bed.”

“I liked using certain pockets of free time throughout my day to try to meditate instead of overthinking about problems in life. It is also soothing and does relax your mind if done properly.”

“It was a good way to relax.”

“Relaxing, refreshing.”

“I like the different amount of time exercise (e.g., 5, 10, 15 minutes).”

“There are trial exercises to ease me into the app.”

“The woman’s voice is very soothing to listen to.”
Chapter 5: Discussion

Summary

Results of our study indicated that there was a significant difference in physiological stress (HRV) scores between the experimental and control groups, with a large effect size. The students who utilized the mindfulness training app had a larger overall decrease in physiological stress scores (i.e., increase in HRV), than did the control group, with the intervention group’s post-test HRV scores increasing 2.91%, while the control group’s post-test HRV scores decreased 4.80 points from their pre-test HRV scores. Although not statistically significant, the intervention group exhibited a higher overall increase in mindfulness, decrease in psychological stress, stereotype threat (gender stigma consciousness and ethnicity stigma consciousness), and lower levels of maladaptive coping (denial and behavioral disengagement) as compared to the control group.

Overall, the mindfulness training app appeared to be relatively easy to use and effective for managing stress, as 90.9% of the students using the mindfulness training app rated the tasks required by the intervention as being either easy or very easy; 90.9% endorsed either agreeing or strongly agreeing that they found the intervention useful; and 81.8% endorsed either agreeing or strongly agreeing that they would suggest this type of practice for stress management.

While there is ample evidence illustrating the many benefits of mindfulness-based interventions for both clinical and nonclinical populations, the vast majority of these programs are time intensive, requiring both in- and out-of-session practice, and can be difficult for people with minimal experience with meditation. According to Carmody and Baer (2009), the consequence of this commitment could cause barriers to its widespread application. To overcome these limits, brief mindfulness meditation protocols have been developed and their
efficacy supported for nonclinical populations who are at risk for stress-related health problems (Klatt, Buckworth, & Malarkey, 2009; Olivo et al., 2009; Tang et al., 2009). Nevertheless, only a few studies have integrated them in self-help interventions supported by new technologies such as mobile apps (Carissoli, Villani, & Riva, 2015), and despite the growing interest, research on both the design and potential uses of mindfulness-based mobile applications is scarce (Plaza et al., 2013). Therefore, our pilot study was conducted to explore the effectiveness of a brief self-help protocol using a mindfulness training application delivered via smartphone for managing stress in a university student population.

A detailed discussion of the study’s research questions and the results from our hypotheses’ testing follows:

**Research Question #1**

1. Can four-week smartphone-based mindfulness app training reduce stress levels in a university student population?

Our results indicate that there was a significant difference in physiological stress scores (HRV) between the two groups. Partial eta squared was .237, which based on Cohen’s (1988) convention for effect size indicates a large effect size. Students who utilized the MF app had a larger overall decrease in physiological stress scores (i.e., a larger increase in HRV), than did the control group.

However, there was not a significant difference in MF scores between the two groups. However, students who utilized the MF app did have a higher overall increase in MF scores, than did the control group, increasing 5.76%, as compared to a 0.33% increase in MF score for the control group. Additionally, results indicated that there was not a significant difference in perceived stress scores between the two groups, however, students who utilized the MF app did
have a larger overall decrease in perceived stress, than did the control group, decreasing 9.18%, as compared to a 5.33% decrease in perceived stress score for the control group.

There are numerous studies illustrating the effectiveness of an 8-week course of mindfulness training for stress management, however, very few studies have examined programs that are shorter in duration; and the results are inconclusive. For example, Baer, Carmody, and Hunsinger (2012) examined weekly changes in self-reported mindfulness and perceived stress in participants who completed an 8-week course in mindfulness-based stress reduction (MBSR). Participants were 87 adults with problematic levels of stress related to chronic illness, chronic pain, and other life circumstances who participated in MBSR at an academic medical center. Participants’ mean age was 48.83 years (SD=10.60, range=24-79) and 67% were female. Most (67%, n = 58) were married or cohabitating, whereas 12.6% (n = 11) were single, 12.6% (n= 11) were separated, divorced, or widowed, and 8% (n=7) did not answer this question. Most participants reported white collar and professional occupations. No racial or ethnic demographics were given in the study. The participants completed weekly self-report assessments of mindfulness skills and perceived stress. The researchers hypothesized that significant improvement in mindfulness skills would precede significant change in stress. They found that mindfulness skills and perceived stress both changed significantly from pre-treatment to post-treatment; and that significant increases in mindfulness occurred by the second week of the program, whereas significant improvements in perceived stress did not occur until week four. Thus, the extent of change in mindfulness skills during the first three weeks predicted change in perceived stress over the course of the intervention.

The study provides evidence that changes in mindfulness precede changes in perceived stress in a standard MBSR course and is consistent with previous studies suggesting that
improvements in mindfulness skills may mediate the effects of mindfulness training on mental health outcomes (Baer et al., 2012). This study also has implications in discovering the most cost-effective length of intervention; which can still produce similarly desirable health effects, yet within a shorter and more accessible time frame.

One particular study sought to reduce this timeframe down to three weeks, using a mindfulness-based protocol delivered via smartphone. Carissoli, Villani, and Riva (2015) explored the efficacy of a 3-week mindfulness protocol delivered via smartphone in reducing stress in an adult population. The participants were divided into three different conditions (mindfulness group, relaxation/music group control group, and a waitlist control group). The mindfulness group was instructed to practice mindfulness meditations two times per day, lasting 15 minutes each. They were free to choose from guided or free meditations that were supported by the smartphone app “It’s time to relax!” Music listeners had to use their mobile device to listen to two pieces of relaxing music (chosen from a proposed list); lasting 15 minutes each, while doing nothing else. The waitlist group with no intervention was assessed at the same time as the other two groups, that is, before and after the full interventions. They assessed perceived stress using the Mesure du Stress Psychologique (MSP) at the beginning and end of the protocols. The MSP evaluates perceived stress within the preceding three months, and includes 49 items in six different dimensions, including, loss of control and irritability, psychophysiological feelings, sense of effort and confusion, depressive anxiety, pain and physical problems, and hyperactivity and accelerated behaviors.

In addition, participants were surveyed at the completion of their respective protocols about the “ease of use” and “usefulness” of the intervention, using a five-point Likert scale. Questions related to difficulty were “How did you find the tasks required by the testing?” and
“How did you find the detection of heartbeats?” (1= “very difficult”, 5=”very easy”). Questions related to usefulness were “Did you find the trial useful?” and “Would you suggest this type of practice for stress management?” To obtain a composite measure, the sum of the two items was averaged for a single mean score.

Their results did not show any significant differences between groups, but both the mindfulness and relaxation/music group demonstrated improvements in coping with stress compared to the waitlist group (who experienced an increase in perceived stress). Both the mindfulness group and relaxation/music group reported a significant decrease in average heartbeats per minute after each session. Both groups evaluated the interventions as simple (meditation: M=3.65; music: M=2.08) and useful (meditation: M=3.65; music: M=3.61).

Although both the mindfulness and relaxation/music group showed improvements in stress response, the researchers believed that having duration greater than three weeks could produce a more significant effect for the mindfulness group, as it may take some time to get comfortable with the practice and to let the psychological and physiological benefits set in. Other limitations discussed included having a relatively small sample size, and concerns over the impact of participants’ subjective preference. The researchers discuss that some studies have shown that the effect of music on stress and anxiety depend on personal preference, and that this issue could also be valid for meditation according to participants’ preferences and abilities.

Nevertheless, this study is one of the first to show that using a mindfulness app can help to reduce stress in certain populations, and that the mindfulness-based intervention was perceived as relatively easy and useful. Although participants felt the mindfulness intervention was easy and useful, the researchers point out that many participants declared that it was not
easy to make time to do the exercises. This challenge of limited time seems to further indicate
an important cost-benefit trade-off, and a desire to have simple and relatively quick methods for
stress management that are not only effective, but that individuals will actually use.

Similarly, Ly et al. (2014) conducted a study which compared the effectiveness of two
smartphone-delivered treatments in participants diagnosed with major depressive disorder. One
of the treatments was based on behavioral activation (BA) and the other on mindfulness. Each
treatment was administered as an 8-week long program. Their results indicated that the two
interventions did not differ significantly from one another. However, for participants with
higher severity of depression, the treatment based on BA was superior to the treatment based on
mindfulness. Conversely, for participants with lower initial severity, the treatment based on
mindfulness worked significantly better than the treatment based on BA (Ly et al., 2014).

Since the 8-week long mindfulness program showed similar efficacy as the BA group,
there may be a potentially fruitful “sweet spot” or optimal treatment duration between the 3-
week program described by Carissoli et al. (2015) and the 8-week program described by Ly et
al. (2014), that could be a cost-effective way to impart the benefits of the mindfulness-based
intervention while mitigating the costs that are associated with it (e.g., time cost, financial cost,
accessibility issues, concerns of stigma, etc.). Thus, results from our 4-week mindfulness
intervention indicate that the intervention length (4-weeks, 90-minutes of mindfulness training
per week) may be an adequate amount of time, and utilizing the free smartphone app may be
considered a relatively easy to use, useful, and cost-effective method for managing stress.

Research Question #2
2. Can four-week smartphone-based mindfulness app training reduce levels of stereotype threat (gender stigma consciousness or ethnicity stigma consciousness) in a university population?

One of the theorized mechanisms which may account for the effect of stereotype threat (ST) is that the cognitive pressure triggered by such threat drains the same cognitive (or working-memory) resources that are implicated in the respective task. A study by Weger et al. (2012) investigated whether mindfulness could be used to moderate stereotype threat, as mindfulness has previously been shown to alleviate working-memory load. Their results showed that performance decrements that typically occur under stereotype threat can be reversed when the individual engages in a brief 5-minute mindfulness task. It is possible that both longer and/or more frequent mindfulness training could further heighten this effect. Although mindfulness may be a promising method for reducing stereotype threat, there are very few studies that have explored this approach.

A study by Hayes et al. (2004) compared both a mindfulness-based intervention and a multicultural training intervention to a biologically-oriented educational control condition in the alleviation of stigmatizing attitudes in drug abuse counselors. All of the interventions were based on a 1-day workshop of equal duration. The mindfulness-based intervention, derived from Acceptance and Commitment Training (ACT), utilized acceptance, defusion, mindfulness, and values methods. Whereas, the multicultural training sensitized participants to group prejudices and biases. Measures of stigma and burnout were taken pre-training, post-training, and after a 3-month follow-up. Results showed that the multicultural training had an impact on stigmatizing attitudes and burnout post-intervention but not at follow-up, but showed better gains in a sense of personal accomplishment as compared to the educational control at follow-
up. Conversely, the mindfulness-based intervention (ACT) had a positive impact on stigma at follow-up, on burnout at post-treatment, and follow-up; and follow-up gains in burnout exceeded those of multicultural training. The mindfulness-based intervention (ACT) also exhibited significant changes in the believability of stigmatizing attitudes. This process mediated the impact of ACT, but not multicultural training, on follow-up stigma and burnout.

While this pilot study was primarily focused on reducing stigma and burnout in behavioral health counselors, the results show some evidence that mindfulness-based interventions can help to reduce stigma, and could potentially help to moderate the impact of stereotype threat for additional populations.

For our study did not find a significant difference in gender stigma consciousness scores between the experimental and control groups. Although not statistically significant, students who utilized the MF app had a slight overall increase in gender stigma consciousness (GSC) scores than did the control group. Although not statistically significant, students who utilized the MF app had a higher overall decrease in ethnicity stigma consciousness (ESC) scores than did the control group, with the intervention group’s post-test ESC scores (M=16.45, SD=8.50) decreasing 1.37 points.

For university students, stereotype threat can impact a variety of academic, social, and emotional areas, ranging from what major one chooses to pursue, to what social groups or clubs one chooses to associate with. However, in order for ST to occur one must: 1) believe the stereotype, and also 2) have a high personal investment in the stereotyped domain (e.g., females and minorities who value mathematics) (Steele, 1997). Responses from participant’s post-intervention debriefing questions illustrated a variety of benefits for coping with stereotype threat (e.g., “Meditation gave inner peace. Made my mind have control of my emotions. Not
being affected by others’ comments.”; “I became more aware/accepting of this (racial discrimination).”; “I feel more confident to meet other people.”; “I have been ignoring or may be trying to cope with gender discrimination.”; “I became more aware/accepting of this (gender discrimination)” with responses which reflect themes of awareness and acceptance. Thus mindfulness may help students become more aware and accepting of stigmatization, as well as helping to moderate the impact of stereotype threat.

**Research Question #3**

3. Can four-week smartphone-based mindfulness app training foster more adaptive coping in a university population?

One of the underlying hypotheses for the study is that mindfulness practices may help to improve resiliency to stressors (i.e., lessen the negative psychological impact of these factors), as well as help to produce a greater sense of agency for combatting and/or transforming these systemic factors (i.e., coping). Mindfulness may help to change both physical structures/processes (e.g., nervous system response, brain development/neuroplasticity); psychological processes (e.g., appraisal of stressful stimulus/events, etc.); as well as behavioral processes (e.g., type of coping strategy, etc.). In theory, mindfulness could help one to become more comfortable and accepting of one’s thoughts and emotions, and thus less likely to engage in avoidant (denial or behavioral disengagement) forms of coping. Further, mindfulness could potentially foster more adaptive coping as one becomes more confident in their ability to handle stressors (i.e., having a more benign/positive appraisal of stressful stimulus/events), as well as potentially having greater psychological flexibility for selecting more effective and adaptive coping strategies.
For our study, three separate one-way ANCOVAs were conducted to assess whether students who utilized the MF training app had higher active coping scores, lower denial scores, and lower behavioral disengagement scores, as compared to students who do not (i.e., vs. the control group). Overall, the results indicated that there were not significant differences between the two groups for any of the three coping styles.

Although not statistically significant, the scores for active coping ran contrary to our hypothesis, in that students who utilized the MF app had a lower overall increase in active coping scores than did the control group, with the intervention group’s post-test active coping scores increasing just 1.29%, while the control group’s post-test active coping scores increased 3.08%. While it is possible that these findings were merely a result of chance; or that perhaps there were other factors that impacted participant’s level of active coping, it is possible that students using the MF app perceived the mindfulness meditation interventions themselves as being more passive/less active, thus impacting their ratings. Although this is purely speculative, it is the only result that ran contrary to our hypothesis, and is supported by some of the responses from the post-intervention debriefing questions in which themes of escape or distraction appeared salient (e.g., “App forces you to slow down for a specific time every day; good to escape from academic stress.”; “Using the app during high moments of stress helped distract my mind from this.”; “It took my mind off of wishing I was home so often, but also allowed me to understand that I should be focusing on why I am here.”). While distraction itself can be a useful strategy for managing stress, it may be thought of as being a less active form of coping, even if considered helpful or beneficial overall.

Concordant with our other two hypotheses, while also not statistically significant, students who utilized the MF app had a lower overall increase in denial scores than did the
control group, and had a lower overall increase in behavioral disengagement scores than did the control group. Thus, it appears that denial and behavioral disengagement may be common forms of coping for the university student population (i.e., being under high levels of stress, procrastinating studying or working on projects, etc.), and while there may be other factors that contributed to these results, it is possible that using the MF app may have helped students to engage in less avoidant styles of coping.

Although our results on students’ coping styles is inconclusive, it is possible that given a longer intervention time to utilize the MF app, or even having a larger sample size on which to base our findings, the MF app could potentially help students to utilize less avoidant forms of coping. Given the unique characteristics of the Millennial college students, it is important to reinforce stress coping mechanisms that can both increase their overall stress tolerance, as well as help them to utilize effective coping strategies to help meet the high demands and high levels of productivity required of this population.

**Summary of Post-Intervention Debriefing Questions (Difficulty/Usefulness)**

A study by Cho, Quinlan, Park, and Noh (2014) explored the determinants of adoption of smartphone health apps among college students. They found subjective norms, health consciousness, health information orientation, and Internet health information use efficacy significantly impact the main components of the Technology Acceptance Model (TAM); namely perceived usefulness and perceived ease of use. Therefore, finding quick and effective methods for managing stress may be especially important for a college-aged population.

For our study, all participants in the intervention group (N=11) completed post-intervention debriefing questions regarding the difficulty and usefulness of the intervention. Students in the intervention group rated the app as easy to use (M=4.45), useful (M=4.18), and
endorsed that they would suggest this type of practice for stress management (M=4.18). Thus, the mindfulness training app appeared to be relatively easy to use and effective for managing stress, as 90.9% of the students using the mindfulness training app rated the tasks required by the intervention as being either easy or very easy; 90.9% endorsed either agreeing or strongly agreeing that they found the intervention useful; and 81.8% endorsed either agreeing or strongly agreeing that they would suggest this type of practice for stress management.

**Limitations**

There were several limitations in this study:

1) One limitation was small sample size, which impacted the power of the study. There were a number of factors that impacted our sample size including our overall relatively short data collection time frame (i.e., having a 5-6 month data collection window); having nearly a full month off of data collection (i.e., due to the university’s winter break); and the limited amount of both financial and time-related resources (i.e., paying participants $10 each; paying drawing winner $50; having one data collector/researcher; having a relatively low budget for participant recruitment; and having limited availability to meet with participants, which was mainly during evening and/or on weekends). It is possible that with a larger sample size, and hence greater power, other study findings that were concordant with our hypotheses (though not statistically significant), may have reached a level of statistical significance. However, being a pilot study, a relatively smaller sample size was expected, and though it impacts power when making statistical comparisons between groups, it was less of a limitation in regard to evaluating the difficulty and usefulness of the mindfulness intervention. As such, if participants had endorsed the intervention as being highly difficult, or had not found the intervention to be useful for
managing stress, then there may have been less of a rationale for future studies to carry out a similar protocol using a larger sample size.

2) For our study design, a controlled pragmatic trial was used. Controlled pragmatic trials are typically designed to test the effectiveness of interventions in real life in order to maximize their applicability and generalizability (Patsopoulos, 2011). The downside to prioritizing applicability and generalizability is that there was the potential impact of such factors as non-specific therapeutic effects of social support, participant maturation and/or the passage of time, participant preferences or past experience with mindfulness or meditation, interactions with research staff, awareness of treatment condition; and contextual variables such as fluctuations in stress levels during semester (e.g., the impact on stress and/or participants’ responses due to having a mid-term or final on the day of data collection; or participants having any unusual circumstances which could have impacted their responses, such as the death of a loved one or a break-up in a relationship, etc.). There is also the impact of having a lack of statistically significant differences between groups on mindfulness scores, which makes it difficult to state that the reduction in physiological stress (increase in HRV) was specifically due to the MF intervention. While the use of a controlled pragmatic trial was likely a beneficial design for our particular study, these limitations should be considered, especially given the relatively small sample size which may accentuate any particular limitation.

3) Finally, while the data collection process went relatively smoothly, there were a few participants that had questions pertaining to the Coping style questionnaire, The Brief COPE (Brief COPE; Carver, 1997). For one, a couple of participants expressed feeling that the measure was overly general or vague (particularly in reference to one of the questions, “I’ve been giving up trying to deal with it”). Secondly, it seems possible that some participants may view the
process of meditation as being a non-active form of coping (i.e., avoidance and/or distraction), which fits with some of the responses from our post-intervention debriefing questions (Q3-Q9). Although again, this is purely speculative, it is the only result that ran contrary to our hypothesis, and is supported by some of the responses from the post-intervention debriefing questions in which themes of escape or distraction appeared salient (e.g., “App forces you to slow down for a specific time every day; good to escape from academic stress.”; “Using the app during high moments of stress helped distract my mind from this.”; “It took my mind off of wishing I was home so often, but also allowed me to understand that I should be focusing on why I am here.”).

While distraction itself can be a useful strategy for managing stress, it may be thought of as being a less active form of coping, even if considered helpful or beneficial overall. And while there certainly can be individual differences in regard to coping preferences, or perspectives on whether a strategy is active or passive, it is possible that an individual with limited experience in mindfulness may view it as a method of distraction (whether beneficial or not), and thus may initially view it as being a passive method of coping. Thus it is possible that as an individual’s experience with mindfulness increases, and they potentially come to see the various benefits (such as helping to manage stress), and they come to have a deeper philosophical understanding of it (i.e., actively turning “toward” their experiences rather than “away” or “against” them), they may view the practice of it as being a more active form of coping. In light of these limitations, it may be more suitable to find an alternative coping style questionnaire, which could mitigate some of the issues and confusion around participants responses and the associated findings.

**Statement of Positionality**

McDowell (1992) noted that researcher should evaluate their own position in relation to various aspects of their study, including the research participants and the broader research
setting. These aspects can include assessing and reflecting on the potential impacts and interactions involved throughout the study, involving such areas as education, class, race, gender, ethnicity, culture, participant and researcher roles, as well as other factors, which can help to inform and illuminate the broader context of the study. Since bias remains a naturally occurring human characteristic, positionality is often used in the context of the inductive approach to social science inquiry as an exploration of the investigator’s reflection on one’s own placement within the many contexts, layers, power structures, identities, and subjectivities of the viewpoint (England, 1994).

Likely one of the most impactful areas was my being a “majority” researcher (white, male) with a predominantly minority sample of research participants (e.g., 66.7% female, 52.4% non-white). This coupled with my explicit role as the researcher (i.e., being in a position of authority or being perceived as an expert on the topic); inherent differences in age-levels (i.e., my age of 38 years-old versus participants’ mean age of just under 21 years-old); education-levels (i.e., my being a doctoral student/professional practitioner versus participants being mostly undergraduates (71.4%) and master-level students (28.6%)), and the potential of being perceived as a “mentor” or “adviser” for those in the field of psychology (42.9%) or related fields, could all have associated impacts on the study.

Some potential benefits of this position of authority was an overall sense of respect and professionalism exhibited by the participants. I only had one prospective participant (not included in the study) who “no-showed” for the initial appointment, with two other participants who dropped out after the initial appointment due to having increasingly busy schedules (both of whom were very apologetic and responded both politely and respectfully). The remaining twenty-one participants were very punctual to their appointments; followed protocol with good
fidelity; and were conscientious and responsive during all communications (emails, phone calls, etc.).

However, some potential drawbacks to this position of authority included the possibility of a heightened observer-expectancy effect (or experimenter effect) whereby my own cognitive biases (attitudes, values, interests, roles) could subconsciously influence participants in the study. This could include such things as participants inferring a strong interest of mine in mindfulness or novel health technologies. Additionally, my position as researcher could potentially influence and/or create heightened demand characteristics whereby participants might form an interpretation of the study’s purpose and subconsciously change their behavior to fit that interpretation. This could include participants being “aware” of their study group, and thus impacting their behaviors or responses (e.g., endorsing lower stress following the intervention, or endorsing higher ratings on intervention difficulty or usefulness). Of course, participant responses could be biased in the other direction as well.

This influence may have been particularly salient when it came to the qualitative aspects of the study, such as the open-ended questions which addressed areas of diversity and discrimination (e.g., gender and ethnicity), as well as other potentially sensitive areas such as financial or economic strain or concerns. It is possible that participants could have over- or under-reported due to my positionality (status as white male). Additionally, what was notable for me was being explicitly aware (through participants’ responses to the debriefing questions) that even these seemingly high-functioning and high-achieving, possibly mid-to-high SES students at a competitive and highly reputable university in the Northeastern US were still frequently subjected to a variety of gender and ethnicity-related forms of discrimination or oppression. While I feel the country as a whole is making some progress in these areas
(compared to many decades and/or centuries ago, at least), it clearly shows that there is still a great deal of progress that needs to be made, and that these forms of discrimination (both overt and often times subtle) can occur regardless of one’s level of education, achievement, or SES.

Another impactful area that presented me with my own personal and professional challenge was in my striving to remain within my ascribed role as an objective, “somewhat distant” researcher (i.e., having boundary and role-limitations, etc.). Although I feel at this point that I have had enough experience in this area to have done it within perfectly appropriate and suitable standards, there were many times when I wished I was operating from a more personal level, or in an alternative role as a therapist/clinician, teacher, mentor, or adviser. For example, there were many participants that had an interest or curiosity around the greater intention, design, and prospective results of the study than what was appropriate to discuss at that time (however, I could discuss a little more when debriefing at the end of the study, though).

Additionally, there were a few participants that expressed interest in a similar field as my own, and thus seemed to solicit advice or recommendations for various matters (e.g., schooling, research/clinical experiences, areas of study, etc.). Although I will acknowledge that I personally very much enjoy advising or mentoring students/people, I did feel limited at times in how much I could discuss with them and thus had to do plenty of self-monitoring around being “helpful”, and staying in my role as an objective, distanced researcher (including having to provide explanations around my limitations as a researcher). Finally, there were many participants (probably more than half of the participants) that seemed to solicit advice or recommendations for stress management strategies, and thus I needed to self-monitor my own interactions to avoid taking on the role of clinician or therapist.

Recommendations for Future Research
One of the single biggest recommendations for future research would be to obtain a larger sample size. There is limited research overall on using a mindfulness app for managing stress (let alone stereotype threat or coping style), and thus additional studies with larger sample sizes can help to ascertain whether using a mindfulness training app for 4-weeks (at 90-minutes per week) can help in managing stress. Although the intervention length was specific and purposeful, it is possible that having a more intensive intervention time (2-3 hours rather than 90 minutes), or a longer intervention duration (perhaps 5 weeks) could heighten any therapeutic effect.

Additionally, while this study purposefully explored this intervention with a university student population in the Northeast, it may be beneficial to explore this same intervention with students from different regions of the country or world. In addition to geographical diversity, it is highly recommended for future research to strive to include larger samples of underrepresented populations, and greater overall ethnic/cultural diversity (i.e., Hispanic, African-American, etc.), as certain stressors such as stereotype threat may be more salient for these populations. This could have important implications for assessing the effectiveness of a mindfulness training app for reducing the negative impacts of stereotype threat (e.g., ethnicity stigma consciousness scores) for students representing these populations.

Finally, it may also be interesting to explore whether various non-student populations have similar results. That is, using a smartphone app may be particularly practical for student populations who tend to utilize smartphones more routinely and may have greater experience in using health-related apps (or just apps in general). The ubiquitous use of smartphones in this population, coupled with their limited amount of free time may make this intervention more suitable than for other populations.
REFERENCES


Cleland, J., Caldow, J., & Ryan, D. (2007). A qualitative study of the attitudes of patients and
staff to the use of mobile phone technology for recording and gathering asthma data.
Journal of Telemedicine & Telecare, 13(2), 85-89.

Routledge Academic.

Social Psychology, 42(6), 1320-1334.

Cohen, S., Janicki-Deverts, D., & Miller, G. E. (2007, 10/10/). Psychological stress and disease,

Journal of Health and Social Behavior, 24, 385-396.

value proposition in the widespread use of telehealth. Journal of Telemedicine &
Telecare, 14(4), 167-168.

of the effectiveness of an acceptance-based behavioral therapy program on psychological

Debra Parker, O., & George, D. (2010). Comparing face-to-face and telehealth-mediated
delivery of a psychoeducational intervention: A case comparison study in hospice.
Telemedicine & e-Health, 16(6), 751-753.


Yi-Yuan, T., Yinghua, M., Yaxin, F., Hongbo, F., Junhong, W., Shigang, F., . . . Ming, F. (2009). Central and autonomic nervous system interaction is altered by short-term


Appendix A:
Demographics Questionnaire

Please answer the following questions:

1. What is your full name (please print)?

2. What is your SCHOOL email address?

3. What is your mobile/cell number?

4. What is your current age?

5. What is your gender?
   a. female
   b. male
   c. other

6. How would you classify yourself (select one)?
   a. Arab
   b. Asian/Pacific Islander
   c. Black
   d. Caucasian/White
   e. Hispanic
   f. Indigenous or Aboriginal
   g. Latino
   h. Multiracial
   i. Would rather not say
   j. Other

7. What is the highest level of education that you have completed?
   a. Some college
   b. Bachelor’s degree
   c. Master’s degree
   d. Doctoral degree

8. What year are you in your respective academic program?
   a. 1st
   b. 2nd
   c. 3rd
   d. 4th
   e. 5th
   f. 6th
   g. 7th or higher

9. What is your current major?
Appendix B:
Cognitive and Affective Mindfulness Scale-Revised (CAMS-R)
PRE

1. It is easy for me to concentrate on what I am doing.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

2. I am preoccupied by the future.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

3. I can tolerate emotional pain.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

4. I can accept things I cannot change.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

5. I can usually describe how I feel at the moment in considerable detail.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

6. I am easily distracted.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

7. I am preoccupied by the past.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

8. It’s easy for me to keep track of my thoughts and feelings.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

9. I try to notice my thoughts without judging them.
   - Rarely/Not At All
   - Sometimes
   - Often
   - Almost Always

10. I am able to accept the thoughts and feelings I have.
    - Rarely/Not At All
    - Sometimes
    - Often
    - Almost Always

11. I am able to focus on the present moment.
    - Rarely/Not At All
    - Sometimes
    - Often
    - Almost Always

12. I am able to pay close attention to one thing for a long period of time.
    - Rarely/Not At All
    - Sometimes
    - Often
    - Almost Always
Appendix C: Cognitive and Affective Mindfulness Scale-Revised (CAMS-R) POST

1. It is easy for me to concentrate on what I am doing.
   Rarely/Not At All   Sometimes   Often   Almost Always

2. I am preoccupied by the future.
   Rarely/Not At All   Sometimes   Often   Almost Always

3. I can tolerate emotional pain.
   Rarely/Not At All   Sometimes   Often   Almost Always

4. I can accept things I cannot change.
   Rarely/Not At All   Sometimes   Often   Almost Always

5. I can usually describe how I feel at the moment in considerable detail.
   Rarely/Not At All   Sometimes   Often   Almost Always

6. I am easily distracted.
   Rarely/Not At All   Sometimes   Often   Almost Always

7. I am preoccupied by the past.
   Rarely/Not At All   Sometimes   Often   Almost Always

8. It’s easy for me to keep track of my thoughts and feelings.
   Rarely/Not At All   Sometimes   Often   Almost Always

9. I try to notice my thoughts without judging them.
   Rarely/Not At All   Sometimes   Often   Almost Always

10. I am able to accept the thoughts and feelings I have.
    Rarely/Not At All   Sometimes   Often   Almost Always

11. I am able to focus on the present moment.
    Rarely/Not At All   Sometimes   Often   Almost Always

12. I am able to pay close attention to one thing for a long period of time.
    Rarely/Not At All   Sometimes   Often   Almost Always
Appendix D:
Perceived Stress Scale (PSS-10)
PRE

INSTRUCTIONS:

The questions in this scale ask you about your feelings and thoughts during THE LAST MONTH. In each case, please indicate your response by placing the number (0-4) representing HOW OFTEN you felt or thought a certain way.

0=Never
1=Almost Never
2=Sometimes
3=Fairly Often
4=Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?

2. In the last month, how often have you felt that you were unable to control the important things in your life?

3. In the last month, how often have you felt nervous and “stressed”?

4. In the last month, how often have you felt confident about your ability to handle your personal problems?

5. In the last month, how often have you felt that things were going your way?

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

7. In the last month, how often have you been able to control irritations in your life?

8. In the last month, how often have you felt that you were on top of things?

9. In the last month, how often have you been angered because of things that were outside your control?

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

HRV Pre=
Appendix E:
Perceived Stress Scale (PSS-10)
POST

INSTRUCTIONS:

The questions in this scale ask you about your feelings and thoughts during THE LAST MONTH. In each case, please indicate your response by placing the number (0-4) representing HOW OFTEN you felt or thought a certain way.

0=Never
1=Almost Never
2=Sometimes
3=Fairly Often
4=Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?

2. In the last month, how often have you felt that you were unable to control the important things in your life?

3. In the last month, how often have you felt nervous and “stressed”?

4. In the last month, how often have you felt confident about your ability to handle your personal problems?

5. In the last month, how often have you felt that things were going your way?

6. In the last month, how often have you found that you could not cope with all the things that you had to do?

7. In the last month, how often have you been able to control irritations in your life?

8. In the last month, how often have you felt that you were on top of things?

9. In the last month, how often have you been angered because of things that were outside your control?

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

HRV Post=
Appendix F: Gender Stigma Consciousness (GSC) and Ethnicity Stigma Consciousness (ESC) subscales PRE

Subscales derived from the Social Identities and Attitudes Scale (SIAS; Picho & Brown, 2011):

*Scoring based on 7-point-Likert Scale:*
1 = strongly disagree
2 = disagree
3 = somewhat disagree
4 = neither agree or disagree
5 = somewhat agree
6 = agree
7 = strongly agree

**Gender Stigma Consciousness subscale (GSC):**
13. Most people judge me on the basis of my gender
5. My gender influences how teachers interpret my behavior
30. Members of the opposite sex interpret my behavior based on my gender
18. My gender affects how people treat me
24. My gender affects how people act towards me

**Ethnicity Stigma Consciousness subscale (ESC):**
9. Most people judge me on the basis of my ethnicity
31. My ethnicity influences how teachers interact with me
36. People from other ethnic groups interpret my behavior based on my ethnicity
27. My ethnicity affects how my peers interact with me
33. My ethnicity affects how I interact with people of other ethnicities
Appendix G:
Gender Stigma Consciousness (GSC) and Ethnicity Stigma Consciousness (ESC) subscales

POST

Subscales derived from the Social Identities and Attitudes Scale (SIAS; Picho & Brown, 2011):

Scoring based on 7-point-Likert Scale:
1 = strongly disagree
2 = disagree
3 = somewhat disagree
4 = neither agree or disagree
5 = somewhat agree
6 = agree
7 = strongly agree

Gender Stigma Consciousness subscale (GSC):
13. Most people judge me on the basis of my gender
5. My gender influences how teachers interpret my behavior
30. Members of the opposite sex interpret my behavior based on my gender
18. My gender affects how people treat me
24. My gender affects how people act towards me

Ethnicity Stigma Consciousness subscale (ESC):
9. Most people judge me on the basis of my ethnicity
31. My ethnicity influences how teachers interact with me
36. People from other ethnic groups interpret my behavior based on my ethnicity
27. My ethnicity affects how my peers interact with me
33. My ethnicity affects how I interact with people of other ethnicities
Appendix H:
Brief COPE
PRE

These items deal with ways you've been coping with the stress in your life since you found out you were going to have to have this operation. There are many ways to try to deal with problems. These items ask what you've been doing to cope with this one. Obviously, different people deal with things in different ways, but I'm interested in how you've tried to deal with it. Each item says something about a particular way of coping. I want to know to what extent you've been doing what the item says. How much or how frequently. Don't answer on the basis of whether it seems to be working or not—just whether or not you're doing it. Use these response choices. Try to rate each item separately in your mind from the others. Make your answers as true FOR YOU as you can.

1 = I haven't been doing this at all
2 = I've been doing this a little bit
3 = I've been doing this a medium amount
4 = I've been doing this a lot

2. I've been concentrating my efforts on doing something about the situation I'm in.

3. I've been saying to myself "this isn't real."

6. I've been giving up trying to deal with it.

7. I've been taking action to try to make the situation better.

8. I've been refusing to believe that it has happened.

16. I've been giving up the attempt to cope.
Appendix I:  
Brief COPE  
POST

These items deal with ways you've been coping with the stress in your life since you found out you were going to have to have this operation. There are many ways to try to deal with problems. These items ask what you've been doing to cope with this one. Obviously, different people deal with things in different ways, but I'm interested in how you've tried to deal with it. Each item says something about a particular way of coping. I want to know to what extent you've been doing what the item says. How much or how frequently. Don't answer on the basis of whether it seems to be working or not—just whether or not you're doing it. Use these response choices. Try to rate each item separately in your mind from the others. Make your answers as true FOR YOU as you can.

1 = I haven't been doing this at all
2 = I've been doing this a little bit
3 = I've been doing this a medium amount
4 = I've been doing this a lot

2. I've been concentrating my efforts on doing something about the situation I'm in.

3. I've been saying to myself "this isn't real."

6. I've been giving up trying to deal with it.

7. I've been taking action to try to make the situation better.

8. I've been refusing to believe that it has happened.

16. I've been giving up the attempt to cope.
Appendix J: Post-Intervention Debriefing Questions

Three questions will be asked post-intervention (to treatment group only) to assess the participants’ level of difficulty with the intervention, as well as their perceived usefulness of the intervention.

Q1. How did you find the tasks required by the intervention? (Difficulty)

1=very difficult
2=difficult
3=neutral
4=easy
5=very easy

Q2. Did you find the intervention useful? (Usefulness)

1=strongly disagree
2=disagree
3=neither agree nor disagree
4=agree
5=strongly agree

Q3. Would you suggest this type of practice for stress management? (Usefulness)

1=strongly disagree
2=disagree
3=neither agree nor disagree
4=agree
5=strongly agree

Additionally, six open-ended questions will be asked post-intervention (treatment group only) to assess the role of diversity in mindfulness training. The open-ended questions will
ask participants to “Please discuss if and how this research on mindfulness assisted you in dealing with each of the following areas:”

Q4. Racial discrimination (if applicable)

Q5. Gender discrimination (if applicable)

Q6. Economic strain (if applicable)

Q7. Acculturation issues (i.e., adapting/immigrating to the local culture—school, campus, city, state, country) (if applicable)

Q8. Academic achievement (if applicable)

Q9. What (if anything) did you like about the intervention (if applicable)?
Research Participants Needed!!!

Are you interested in participating in a research study about stress?

Requirements for participation:
- Are a registered student at Northeastern University or the University of Buffalo
- Are 18 years of age or older
- Own a smartphone (that you have access to on a day-to-day basis)
- Are available for the full 4-week study duration; including two 30-minute in-person appointments (one at the beginning of the study and one at the end of the study), as well as 90-minutes per week available for independent self-guided practice/participation

Compensation for participation:
- Participants will be paid $10.00 cash for full completion of the study, and will be entered into a raffle for the chance to win $50.00 cash.

If you meet the above requirements and would like to learn more about the study, please contact Brian via email: Siembor.b@husky.neu.edu (preferred) or by phone: (603) 674-2210.
Appendix L: Telephone/Email Recruitment Script

Telephone/Email Recruitment Script

Dear Prospective Participant,

Thank you for your interest in our research study. As indicated in our posting, we are conducting a study about stress. In order to be eligible for our study, you will need to meet all of the following criteria:

- Are a registered student at Northeastern University or the University of Buffalo
- Are 18 years of age or older
- Own a smartphone (that you have access to on a day-to-day basis)
- Are available for the full 4-week study duration; including two 30-minute in-person appointments (one at the beginning of the study and one at the end of the study), as well as 90-minutes per week available for independent self-guided practice/participation

If you meet ALL of the above criteria and are further interested in participating in our research study, please let us know as soon as possible. We can then schedule a 30-minute orientation session (in a private study room on campus), where we will provide you with an overview of the study, including detailed instructions for participation, and complete any associated study paperwork (i.e., consent forms, assessment forms, and remuneration contract).

If you consent to participating in the study (i.e., have signed the informed consent form and study remuneration contract; both completed at the orientation session), and have completed all requirements of the study in its entirety, you will be compensated with $10.00 cash and will be entered in a raffle for $50.00 cash.

Again, if you are interested in participating in our study and would like to schedule a 30-minute orientation session, or have any further questions about participation, please contact Brian Siembor via email: Siembor.b@husky.neu.edu, or telephone: (603) 674-2210. Thank you.

Sincerely,
Brian Siembor
Appendix M:
Informed Consent Document

Northeastern University, Department of Applied Psychology
Name of Investigator(s): Tracy Robinson-Wood (PI), Brian Siembor
Title of Project: Exploring the effectiveness of a mindfulness training app for managing stress in a university student population.

Informed Consent to Participate in a Research Study
We are inviting you to take part in a research study. This form will tell you about the study, but the researcher will explain it to you first. You may ask this person any questions that you have. When you are ready to make a decision, you may tell the researcher if you want to participate or not. You do not have to participate if you do not want to. If you decide to participate, the researcher will ask you to sign this statement and will give you a copy to keep.

Why am I being asked to take part in this research study?
We are recruiting university students to take part in our study. To be eligible for our study, you will need to meet all of the following criteria:
- Are a registered student at the University of Buffalo
- Are 18 years of age or older
- Own a smartphone (that you have access to on a day-to-day basis)
- Are available for the full 4-week study duration; including two 30-minute in-person appointments (one at the beginning of the study and one at the end of the study), as well as 90-minutes per week available for independent self-guided practice/participation (if necessary)

Why is this research study being done?
The purpose of the study is to explore stress and particular stress management strategies among university students.

What will I be asked to do?
If you decide to take part in this study, we will ask you to attend two 30-minute appointments (one at the beginning of the study and one 4-weeks later at the end of the study). The first appointment will be a short orientation which will include a basic introduction and overview of their respective interventions (approximately 10 minutes), as well as completion of any necessary paperwork (e.g., consent forms) and baseline measures (approximately 20 minutes). You will then independently follow a 4-week protocol for their respective interventions (requiring approximately 15 minutes per day; or approximately 90 minutes per week for the intervention group; and no additional time for the control group); and then BOTH groups’ participants will complete post-intervention measures and final paperwork (approximately 30-minutes) at the end of their 4-weeks. You will be instructed to call and/or email (preferred) the student researcher if they have any questions or concerns with this process. At the completion of your participation in the study, you will receive remuneration and will sign the receipt of study completion and payment form.

Where will this take place and how much of my time will it take?
There will be two 30-minute appointments, both at the beginning of the study and at the end of the study (after 4-week period), that will be held at an appropriate campus location (e.g., private study room on campus). In-between these two appointments, participants will independently follow a 4-week protocol (requiring approximately 15 minutes per day; or approximately 90 minutes per week) that can be completed by the participant independently (i.e., participants can independently choose the particular time and/or location that they complete the study requirements/practices). The specific protocols may depend upon which study group participants have been assigned to. Further details of the study and requirements will be provided at the initial 30-minute appointment.
Will there be any risk or discomfort to me?
There is no foreseeable risk or discomfort, however, in the event of any issue or concern, please contact study administrators and the appropriate agency for assistance (see below for contact information).

Will I benefit by being in this research?
There will be no direct benefit to you for taking part in the study. However, there may be potential benefits to others and/or to society, which could include the contribution to the research literature on stress and stress management for university students.

Who will see the information about me?
Your part in this study will be confidential. Only the researchers on this study will see the information about you. No reports or publications will use information that can identify you in any way or any individual as being of this project.

There are, however, some limits to confidentiality, such as if there is potential for imminent harm to one's self or to others (e.g., suicide, homicide, child abuse, etc.), or if there are any legal circumstances associated with this study, or participants in this study. In rare instances, authorized people may request to see research information about you and other people involved in this study. This is done only to be sure that the research is done properly. We would only permit people who are authorized by organizations such as the Northeastern University Institutional Review Board, to see this information.

What will happen if I suffer any harm from this research?
There is minimal risk associated with participating in this study, however, in the event of any particular concern (i.e., physical, psychological, social, financial or otherwise), it is recommended to contact the appropriate resources for handling such concerns. Both the study administrators' contact info, as well as NEU's Human Subject Research Protection contact info, can be found below. Additionally, you may contact your University's Health and Counseling Services Center. Please note that no special arrangements will be made for compensation or for payment for treatment solely because of your participation in this research.

Can I stop my participation in this study?
Your participation in this research is completely voluntary. You do not have to participate if you do not want to and you can refuse to answer any question. Even if you begin the study, you may quit at any time. If you do not participate or if you decide to quit, you will not lose any rights, benefits, or services that you would otherwise have (as a student, employee, etc.), other than the financial compensation for fully completing the study (see below).

Who can I contact if I have questions or problems?
If you have any questions about this study, please feel free to contact Brian Siembor, the study team leader, via telephone: 603-674-2210 or via email: Siembor.B@husky.neu.edu (preferred). You can also contact Dr. Tracy Robinson-Wood, the principal investigator, via telephone: 617-373-2485 or via email: tr robinson@neu.edu

Who can I contact about my rights as a participant?
If you have any questions about your rights in this research, you may contact Nan C. Regina, Director, Human Subject Research Protection, 490 Renaissance Park, Northeastern University, Boston, MA 02115. Tel: 617.373.4588, Email: n.regina@neu.edu. You may call anonymously if you wish.
EXPLORING THE EFFECTIVENSS OF A MINDFULNESS TRAINING APP

Will I be paid for my participation?
All participants who have fully completed the study will receive $10 cash, paid at the final/follow-up appointment (approx. 4 weeks after starting the study). Also, all participants who have fully completed the study will be entered in a raffle for a chance to win $50 cash (there will be one winner for the raffle total; paid after completion of the study’s data collection period).

Will it cost me anything to participate?
There will be no financial cost to the participant for participating in the study.

Is there anything else I need to know?
Feel free to ask the student researcher any questions that you may have.

I agree to take part in this research.

______________________________
Signature of person agreeing to take part

______________________________
Date

______________________________
Printed name of person above

______________________________
Signature of person who explained the study to the Participant above and obtained consent

______________________________
Date

______________________________
Printed name of person above