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Mobile Mindfulness: There's an App for That!

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MOBILE MINDFULNESS: THERE'S

AN APP FOR THAT!

being

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ABSTRACT

Previous research indicates that practicing mindfulness-based strategies over an extended period of time may positively impact individuals' well-being, such as improved mood and cognitive performance (Chambers, Lo, & Allen, 2008; Kabat-Zinn, 1990; Kabat-Zinn, 2003; Mrazek, Franklin, Phillips, Baird, & Schooler, 2013). This research also indicates there may be immediate benefits to practicing mindfulness strategies; however, a majority of the existing literature on this topic has focused primarily on extended mindfulness-practices over several weeks with an in-person guide or trained researcher. The purpose of the current study was two-fold. First, how practicing one of two mindfulness-based strategies for a short period of time (e.g., less than two minutes per day over a one week period) influenced several psychological variables of interest (i.e., attention and awareness, depression, anxiety, stress, mood, and cognitive performance) was assessed. Second, the short mindfulness-based strategies were guided by a mobile-phone application; thus, the effectiveness of practicing mindfulness without the physical presence of a guide or researcher trained in meditation was assessed.

Participants came to an initial lab session (Time 1) and completed self-report measures assessing the variables of interest along with a cognitive task to test their working memory capability. Participants either learned and practiced one mindfulness-based strategy (mindful breathing or a body scan) or engaged in a no-strategy (control) condition. After the initial lab session, participants in the mindfulness strategy conditions were instructed to practice the strategy on their own for three days using a mobile-phone application. Participants returned to the lab for a final lab session (Time 2) and once

again practice the assigned mindfulness strategy, answered the self-report questionnaires, and completed the cognitive task.

Based on previous research, it was hypothesized that participants in the mindful breathing and body scan conditions compared to the control condition would show increases in attention and awareness, positive affect, and cognitive performance from the initial lab session (Time 1) to the final lab session (Time 2). It was also hypothesized that participants in the mindful breathing and body scan conditions compared to the control condition would show decreases in depression, anxiety, stress, and negative affect from Time 1 to Time 2. Seventy-four participants completed all parts of the current study; there were not significant differences across conditions and time on most of the self-report measures. However, there was a significant main effect of time on negative affect and performance on the cognitive task. Exploratory analyses were conducted to further probe the data for relationships between the variables of interest. A negative correlation between self-reported mindfulness, attention, and awareness was found in relation to depression, anxiety, stress, and negative affect. Although not significant, a positive correlation between self-reported mindfulness, attention, and awareness was found in relation to positive affect and cognitive performance.

The results suggest that more research is needed on the effect of brief mindfulness practices guided by a mobile-phone application. Contributions of the current study, as well as future research and limitations, are discussed.

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INTRODUCTION

Importance of the Problem

In recent years, levels of reported stress have increased in the United States, and as a result, researchers have linked levels of physical and emotional well-being to the amount of stress experienced; namely, the more perceived and actual stress experienced, the more severe the physical and mental negative symptomology potentially becomes (e.g., headaches, depression, anxiety, sleeplessness, hypertension, and digestive problems; Kinman & Jones, 2005). When individuals are under enough stress, not only does mental and physical health suffer, but also the motivation and ability to complete tasks efficiently and effectively (Cohen, 1980; Kimhi, 2015; Struthers, Perry, & Menec, 2000). Importantly, meditation is one strategy that has been shown in previous research to help individuals reduce and manage stress, improve productivity, and enhance overall well-being (Baer, 2003; Kabat-Zinn, 2003; Shapiro, Carlson, Astin, & Freedman, 2006). Prior research indicates that there are a variety of meditation strategies individuals may engage in to improve overall well-being (Deyo, Wilson, Ong, & Koopman, 2009; Snippe, Nyklíček, Schroevers, & Bos, 2015) as well as promote attention and awareness (Chambers et al., 2008; Mrazek, Franklin, Phillips, Baird, & Schooler, 2013; Shapiro, Oman, Thoresen, Plante, & Flinders, 2008; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010). However, one meditation practice that has been shown to improve these areas simultaneously, along with additional areas such as affect and/or cognitive performance, is mindfulness meditation (Baer, 2003; Kabat-Zinn, 2003).

Mindfulness meditation is generally defined as the act of being aware, paying attention to the present moment, including the internal and external experiences of each

moment, without judgement (Baer, 2003; Brown & Ryan, 2003; Deyo et al., 2009; Garland, Gaylord, & Fredrickson, 2011; Kabat-Zinn, 2003). Internal experiences may include thoughts, emotions, and bodily sensations that individuals recognize, whereas external experiences may include awareness of environmental aspects, such as sounds and sights (Baer, 2003; Kabat-Zinn, 1990). Shapiro and colleagues (2006) describe mindfulness as a combination of three components: 1) intention — engaging in the practice "on purpose," 2) attention — observing one's moment-to-moment experiences as opposed to ruminating on past memories or future planning, and 3) attitude — approaching mindfulness practices in an openhearted, interested, and invested manner. Although mindfulness may be practiced through a variety of strategies, such as relaxation or mindful awareness to a sound or visual stimuli (Deyo et al., 2009; Snippe et al., 2015), the proposed study focused solely on two mindfulness strategies: mindful breathing and a body scan. These two strategies were selected based on prior research supporting their effectiveness as part of a collection of practices that might improve health and well-being following prolonged practice (Baer, 2003; Kabat-Zinn 1990). These strategies also were selected based on the purpose of each strategy being similar. Below, relevant research and information about the purpose and effectiveness of both strategies is reviewed in detail.

The Purpose of Mindfulness-Based Strategies

Mindful breathing is a strategy that allows individuals to stay grounded in the present moment through focused attention on the act of inhaling and exhaling the breath (Feldman, Greeson, & Senville, 2010; Mani, Kavanagh, Hides, & Stoyanov, 2015). Individuals are instructed to remain in the present moment by focusing on the physical

sensation of their breath — stomach going up and down, breath going through the nostrils — and to let go of passing thoughts that distract focus away from the breath. An important element of a mindfulness-breathing practice is the acknowledgement that it can be difficult to stay focused on the breath for an extended period of time (Baer, 2003; Kabat-Zinn, 2003). That is, mindful practices support the notion that it is natural for individuals to have thoughts about things beyond the breath. For example, individuals may have thoughts about tasks they must complete throughout the day that may interrupt their focus on the breath. Mindfulness as a practice allows individuals to acknowledge these thoughts and interruptions/distractions in a non-judgmental manner (i.e., acknowledging that these distractions are common) and encourages individuals to gently let these distractions pass before bringing attention and focus back to the breath. Overall, the practice of mindful breathing helps individuals to develop skills needed to be focused and attune to the present moment.

A body scan also is considered a mindfulness strategy. Similar to a mindful breathing exercise, a body scan may help individuals to practice remaining grounded in the present moment in a non-judgmental and intentional manner (Mirams, Poliakoff, Brown, & Lloyd, 2013). During a body scan, individuals slowly moves focus from one area of the body to the next in a sequential pattern (e.g., from the head to the neck; neck to back; back to stomach; stomach to legs), bringing attention to any pains or sensations in the body before moving to the next area (Mani et al., 2015; Mirams et al., 2013). The individuals stay in the present moment by focusing on what their body is experiencing and bringing attention and non-judgmental awareness to that experience.

Important for the current study, mindful breathing and a body scan are two techniques that individuals may practice to be present in the current moment by disengaging from passing thoughts. For either technique, individuals are guided through the exercise with reminders to bring their attention back to the present moment should they become distracted (Baer, 2003; Mirams et al., 2013). Both strategies include instructions that allow individuals to recognize any thoughts that enter their mind as important and worthy of attention; however, the purpose of mindful breathing and a body scan is for individuals to neither repress nor indulge in the thought and bring their attention back to either the breath or the body. In doing so, the individuals are training their brains to focus on the task at hand, either focusing on the breath or the body. Prior research (Baer, 2003; Kabat-Zinn, 1990; Kabat-Zinn, 2003) shows that this practice of acknowledging passing thoughts and training the mind to stay present is helpful, because it allows for individuals to control what their focus and intentions. This aspect of control is critical for both physical and mental health; prior research shows that repetitive rumination about the past or the future as well as a lack of control is positively related to negative health outcomes, such as stress, depression, and anxiety (Deyo et al., 2009; Zeiden et al., 2010).

To illustrate this point further, researchers have developed the following example about a time when college-age students would benefit from a mindfulness-based practice. College students may be worried or ruminating about their "to-do list" (e.g., studying for a test, completing an online quiz, and/or going to work) while taking notes during class; however, worrying about future tasks at times when students cannot work on or control these tasks may lead to increased stress and anxiety (Smith & Alloy, 2009). A technique

like mindful breathing or a body scan might help train individuals to maintain a healthy focus on the present moment and/or the direct task at hand. This might subsequently allow for better outcomes, such as improved affect (Snippe et al., 2015) and productivity (Langer & Moldoveanu, 2000), in addition to better mental and physical health (Baer, 2003). Importantly, both the mindful breathing and body scan strategies emphasize the importance of recognizing a thought and then disengaging from the thought to stay focused on the present moment.

The Practice of Mindfulness Among Young Adults

Continuing with the example provided above, it is important to note that college students compose a unique subset of the population to focus on when examining the effectiveness of mindfulness-based strategies. Individuals enrolled at a university are under similar stress conditions, whether these include interpersonal stressors (e.g., changes in social activities and/or roommate conflicts), intrapersonal stressors (e.g., changes in sleeping or eating habits), academic stressors (e.g., keeping up with the demands of college curriculum and expectations), and/or environmental stressors (e.g., planning time for activities and programs throughout the semester; Ross, Niebling, & Heckert, 1999). Students on the same campus will be exposed to a similar environment, and students from the same program are experiencing similar academic stressors.

Ames and colleagues (2011) describe the process of going away to college as a significant transition for young adults as they adapts to new living arrangements with different individuals. Changes in academic expectations and developing new relationships may impact reported levels of loneliness and depression. College students have expectations set for their academic performance, are expected to perform well in the

classroom, and meet certain academic demands. These students are expected to meet these academic demands while adjusting to a novel and possibly stressful environment — an environment that prior research has shown might not always be suitable for individuals in terms of meeting high academic demands (Chemers, Hu, & Garcia, 2001; Zawadzki, Graham, & Gerin, 2013). Thus, it is reasonable to assume that college students would likely benefit from and be interested to learn strategies, such as mindful breathing and a body scan, that might help them improve their focus and attention, as well as enhance cognitive functioning and overall well-being. To test the effectiveness of mindfulness-based strategies, the population of interest for the current study was college students.

Limitations of Prior Mindfulness Research

Although a large body of prior research on the effectiveness of mindfulness strategies exists (Chambers et al., 2008; Deyo et al., 2009; Johnson, Gur, David, & Currier, 2015; Mrazek et al., 2013; Shapiro et al., 2008), there are two important limitations that will be addressed in the current study. These limitations include elements related to the accessibility of mindfulness-based strategies and the length of time required for individuals to benefit from a mindfulness practice.

Accessibility. A majority of previous research on the effectiveness of mindfulness within a variety of contexts has primarily focused on training individuals to engage in mindfulness with either a trained guide and/or a researcher with expertise and knowledge of mindful practices (Chambers et al., 2008; Deyo et al., 2009; Johnson et al., 2015; Mrazek et al., 2013; Shapiro et al., 2008). This prior research includes having participants meet once or more per week for multiple sessions (i.e., 45 to 120 minutes at a time for six

to eight weeks) with a trained instructor to guide individuals through the mindfulness practice. These in-person practices over an extended period of time with a trained instructor may make the practice inaccessible to the general population. For example, people who do not live near a professional instructor, do not have opportunities to participate in mindfulness research, and/or do not have the time to travel to an instructor are placed at a disadvantage in terms of this beneficial practice not being widely accessible.

In an attempt to address this prior limitation of accessibility, the current study used a mobile mindfulness application that guided participants through a mindfulness practice without an instructor/researcher being present. It was expected that this approach (the use of a mobile application) would make mindfulness practices more accessible to the general population. "*Smiling Minds*" is a mobile-mindfulness phone application that might be an effective resource for educating individuals on what mindfulness is, in addition to training individuals through a variety of mindfulness strategies, such as mindful breathing and a body scan (Mani et al., 2015). By using a mobile-mindfulness phone application, individuals might be better able to practice mindfulness whenever and wherever it is appropriate. In addition to addressing the limitation of accessibility, a second contribution of the current study is the intent to assess the effectiveness of mobile-mindfulness applications in relation to a variety of outcomes (e.g., attention/awareness, mood, depression/anxiety/stress, affect, and cognitive performance). Many mobile-mindfulness applications exist (Mani et al., 2015), however, limited research has examined the extent to which these applications are similarly or equally as effective as guided mindfulness practices with a trained instructor.

Length of training. As mentioned briefly above, previous research on mindfulness has focused on longer sessions of approximately 45-120 minutes per session over a six to eight week period (Chambers et al., 2008; Deyo et al., 2009; Mrazek et al., 2013; Shapiro et al., 2008). Overall, this research indicates that the more time spent engaging in mindfulness-based practices, the more individuals experience the benefits of the practice, such as improved mood, attention/awareness, and cognitive performance (Chambers et al., 2008; Mrazek et al., 2013). However, research has minimally focused on the immediate benefits of practicing mindfulness strategies for a short period of time (e.g., three to five minutes each day for a week), which might be a more realistic timeframe for the general population, especially college-age students.

In connection with making mindfulness strategies more accessible through a mobile-phone application, the current study focused on the effects of practicing mindfulness for a brief time period. By researching the immediate effects of a mindfulness practice for a short period of time, the strategies might become more manageable and more appealing for a variety of individuals. College students might benefit from the mindfulness practices described above; however, students may be more inclined to engage in shorter practices than longer practices over an extended period of time. College students also are a population that has constant access to and attention on mobile devices (Aoki & Downes, 2003). As such, the current study potentially would give students a healthy and beneficial outlet via their phone by introducing them to this mobile-mindfulness application.

In sum, the current study examined how the practice of mindfulness relates to a variety of outcomes, namely attention and awareness, depression, anxiety, and stress,

affect, and cognitive performance. Because young adults are a unique subset of the population who might benefit from mindfulness-based practices, this study examined the effectiveness of mobile-mindfulness applications among college students. Contributions of this work include attempts to address some of the prior limitations in previous research associated with the accessibility of mindfulness training and the length of training sessions. To better understand the theoretical underpinnings of the current study, a detailed review of relevant research regarding the variables and population of interest within the context of mindfulness practices will be discussed.

The Effectiveness of Mindfulness-Based Strategies

The current study examined the effect of two mindfulness-based strategies — mindful breathing and a body scan — in relation to several variables of interest. Based on prior research conducted on mindfulness-based practices, attention and awareness were examined in the current study. Depression, anxiety, and stress also were assessed. Finally, the effect of mindful breathing and a body scan in relation to affect and performance on a cognitive task was examined. These variables were selected based on prior research citing the effectiveness of mindfulness-based practices; however, a limitation of prior research conducted to examine these variables includes a lack of information provided on accessibility and length of training, namely for young adults. The following section provides a review of relevant literature on mindfulness and the effectiveness of mindfulness in relation to these variables of interest.

Enhancing attention and awareness. Previous research suggests that the prolonged practice of a mindfulness-based strategy enhances attention and awareness (Baer, 2003; Chambers et al., 2008; Deyo et al., 2009; Shapiro et al., 2008; Snippe et al.,

2015) and the process of mindfulness training activates functioning in the brain related to maintaining attention (Ott, Hözel, & Vaitl, 2011; Tang, Hözel, & Posner, 2015). The anterior cingulate cortex is one region of the brain consistently linked to mindfulness training and improvements in supporting attention regulation and control; during mindfulness training, this region of the brain is activated (Tang et al., 2015). Training individuals to stay in the present moment improves awareness of their surroundings and provides a means for individuals to concentrate and attend to what is occurring in the present moment. Attention/awareness is one of the first variables that may be impacted as the lateral prefrontal and parietal cortex are the first brain regions to activate and alter through mindfulness training. This might be due to mindfulness requiring mental effort and attentional control when first learning and practicing the strategy (Tang, Rothbart, & Posner; 2012; Tomasino, Fregona, Skrap, & Fabbro, 2013).

Mindfulness training typically spans over a four to eight week period, where participants engage in a different strategy each session to learn to anchor focus to the present moment. For example, in a study by Shapiro and colleagues (2008), 44 undergraduate students were assigned to either an eight-week mindfulness-based meditation program, an eight-week concentration-based meditation program, or a waitlist control condition. The mindfulness and concentration meditation programs consisted of a weekly session, each session lasting approximately 90 minutes. The mindfulness-based meditation group was trained using several practices: mindful sitting meditation (e.g., bringing awareness to bodily sensations, emotions, and thoughts through mindful breathing), a body scan (e.g., sequentially moving attention to different areas of the body, observing any sensations and experiences), mindful movement (e.g., stretching and

posture to increase awareness of and improve balance and strength of muscles), 3-minute breathing space (e.g., a brief breathing exercise to incorporate practice into daily life), and lovingkindness meditation (e.g., focus is on warm and positive emotions) to help develop improved compassion for self, others, and all people. Participants also were taught how to incorporate mindfulness into their daily life.

The concentration-based meditation group was trained using the following: passage meditation (i.e., focus is on a memorized inspirational passage, chosen individually by each participant), focused attention and slowing down (i.e., cultivating mental habits comparable to mindfulness), and mantra repetition (i.e., repetition of a holy name meant to stabilize attention). Participants in the concentration-based meditation group were guided through eight points during the training: sitting meditation, frequent repetition of a mantra during the day, slowing down, focused attention (i.e., moving with care during the day, setting priorities, doing one thing at a time with your full attention), training the senses, putting others first, spiritual fellowship, and inspirational reading (Shapiro et al., 2008).

The mindfulness group focused attention to the present moment with their breath and attention to sensations in the body whereas the concentration group focused on spiritual passages and daily movements. All participants were instructed to practice meditation on their own between the weekly training sessions. The researchers found that individuals who practiced either condition reported similarly high levels of attention and awareness measured using the *Mindfulness Attention Awareness Scale* (*MAAS*; Brown & Ryan, 2003) after eight-weeks of training. The results of this study indicate there are a variety of mindful strategies individuals may engage in to improve attention and

awareness if these strategies are practiced over a prolonged period of time (Shapiro et al., 2008).

This result also has been shown for young adult, novice meditators who attended a week long mindfulness meditation retreat (Chambers et al., 2008). Individuals who completed the retreat (i.e., 8 to 10 hours of focus on the breath and body sensations, observation and acceptance of internal thoughts and experiences) reported higher scores on the MAAS after the training compared to before the training. Although this study had participants go on a retreat to learn how to utilize mindfulness meditation — a practice that is generally inconsistent with daily life routines (e.g., participants away from home, jobs, and families) — this research shows that individuals experience benefits of practicing mindfulness after approximately one week following an initial, extended training session.

Finally, in a similar vein of research, Deyo and colleagues (2009) assessed participants self-selected from the community. Participants attended weekly, 45-minute classes for eight weeks; participants also were instructed to practice meditating for 45 minutes per day over the eight weeks. The weekly classes utilized different strategies, including: a body scan, hatha yoga postures, sitting meditation, and an individualized mix of meditation practices. These trainings had a positive impact on self-reported mindfulness from pre-intervention to post-intervention, suggesting overall improvements in well-being and the ability to engage in awareness. This study, similar to Shapiro and colleagues (2008), focused on an eight-week training program; however, this research (Deyo et al., 2009) differed in relation to session length. The researchers of this study utilized 45-minute training sessions, rather than 90-minute training sessions.

The studies described above examine the impact of mindfulness training for varying session lengths over differing training program spans (from one week to eight weeks); although the length of training varied across the studies, the researchers utilized similar methods of training participants to be mindful. Across these studies, the results support the hypothesis that mindfulness training positively impacts individuals' ability to pay attention and be aware of their internal and external experiences. The current study aims to examine the effectiveness of shorter mindfulness-based training sessions that utilize strategies similar to those in prior research.

Decreasing depression, anxiety, and stress. Previous research supports that engaging in mindfulness-based training may lead to decreases in depression, anxiety, and stress (Chambers et al., 2008; Deyo et al., 2009). When examining how meditation processes impact the brain, electroencephalography (EEG) monitoring shows activation of and alterations in the hippocampus, anterior cingulate cortex, and orbitofrontal cortex — areas of the brain related to emotion regulation (Tang et al., 2015). Research indicates that individuals suffering from anxiety who initially show a negative correlation between activation of the amygdala and the frontal regions of the brain prior to mindfulness training, change to a positive correlation of activity in these regions after training; these individuals were more able to monitor arousal states to manage anxiety symptoms after engaging in mindfulness training (Hölzel et al., 2013). Similarly, alterations in the amygdala impact reactions to stressful events or triggers (Hölzel et al., 2011). When individuals engage in mindfulness training strategies, several regions of the brain are activated and the connectivity of these regions strengthen and improve functioning in daily life for up to four months after training has ceased (Tang et al., 2015).

An abundance of research has been conducted on the effect of mindfulness practices and well-being (that includes depression, anxiety, and stress). This research shows that extended practices (e.g., 8-weeks; Deyo et al., 2009) as well as brief practices of mindfulness for 20 to 25 minutes a day may lower anxiety (Zeidan et al., 2010) and distress (including tension, depression, fatigue, confusion, and vigor; Jain et al., 2007; Johnson et al., 2015). These findings indicate that there may be immediate benefits to practicing mindfulness and mastery over time may enhance the long-term benefits of the practice; however, these studies also suggest that continued research on brief training sessions is warranted to better understand these immediate effects.

Important for the current study, LePera (2011) examined how changes in one factor (e.g., boredom proneness and mindfulness) relate to changes in another area (e.g., anxiety, depression, and substance abuse). The researcher examined trait boredom, mindfulness, anxiety/depression, and lifetime and recent substance abuse. Results suggest an inverse relationship between an individual's mindfulness levels and levels of depression and anxiety, and substance abuse; as an individual's mindfulness increased, their levels of depression and anxiety decreased. Although LePera's (2011) study may not show a direct relationship between mindfulness practices, depression, and anxiety, it adds support to prior literature in that increased levels of attention and awareness may relate to decreased levels of negative affect and negative behaviors related to depression and anxiety (e.g. substance abuse).

Taken together as a whole, the prior research assessing the impact of mindfulness on depression, anxiety, and stress seems to support the positive influence of a mindfulness practice. That is, the research appears to suggest that teaching individuals

how to use mindfulness strategies may help to decrease anxious and/or depressive symptomology as well as decrease the likelihood of engaging in maladaptive behaviors. Two studies cited above (Jain et al., 2007; Johnson et al., 2015), compare the impact of similar strategies hypothesized to impact the variables of interest (i.e., comparing mindfulness meditation to somatic relaxation and comparing mindfulness meditation to sham meditation). These studies suggest it may be beneficial to examine different strategies and how they compare in impacting individuals' perceived moods and experiences. However, more research is needed to assess the immediate benefits (if any) of a shorter mindfulness-based practice on depression, anxiety, and stress.

Promoting positive affect. A prolonged practice of mindfulness has been shown to increase positive affect and decrease negative affect (Chambers et al., 2008; Snippe et al., 2015). Individuals who engage in mindfulness training show increases in left-sided activation of the cortical areas of the brain and a rise in antibody titers; these activations of the left-sided anterior region are related to improved positive emotion expression and the ability to handle negative emotions under stress (Kabat-Zinn, 2003). As previously mentioned, the amygdala is a significant area of the brain impacted by engaging in mindfulness-based strategies and is involved in emotion regulation (Tang et al., 2015). Previous research on the impact of mindfulness strategies on individuals' experiences of positive and negative affect/mood typically utilizes a list of adjectives and measures to what degree individuals recognize that feeling in the present moment (Schroevers & Brandsma, 2010; Snippe et al., 2015).

In a study conducted by Schroevers and Brandsma (2010), the researcher's assessed 64 general community adult participants, ages 23 to 63, with mild anxiety or

depression symptomology before and after completing an eight-week Mindfulness-Based Cognitive Therapy (MBCT) course. The course consisted of techniques used in MBSR training with cognitive therapy elements (Baer, 2003). Cognitive therapy elements facilitate a decentered view on one's thoughts (that thoughts are not facts) and to view thoughts and feelings as short-term events that come and go rather than as characteristics of one's self (Baer, 2003). The researchers examined the effect of MBCT training on participants' self-reported affect measured on the *Positive and Negative Affect Scale* (PANAS; Watson, Clark, & Tellegen, 1988). Sessions during the eight-week course lasted two-and-a-half hours, with a six-hour silence day between weeks six and seven of the course. Participants also were asked to practice the training on a daily-basis at home for 45 minutes; at the end of the course, a majority of participants (84%) reported practicing three to four or five to six times per week. From pre-intervention to post-intervention, participants' reported significant improvements in positive affect (e.g., feeling interested, excited, and strong) and decreased levels of negative affect (e.g., feeling less distressed, upset, and angry).

Next, the clinical sample (participants with anxiety and/or depression) was compared to a large non-clinical sample. At pre-intervention, the clinical sample reported lower positive affect and higher negative affect than the non-clinical sample. At post-intervention, positive affect for the clinical sample was comparable to, yet still slightly lower than, the non-clinical sample. Similarly, at post-intervention, negative affect for the clinical sample was comparable to, yet still slightly higher than, the non-clinical sample. Overall, the mindfulness training seemed to be impactful for both the clinical and non-

clinical samples in relation to positive and negative affect (Schroevers & Brandsma, 2010).

Furthermore, research assessing extended mindfulness-training (i.e., Chambers et al., 2008; Snippe et al., 2015) supports the notion that a mindful practice impacts positive and negative affect. More specifically, individuals who practice a mindfulness-based strategy over an extended period of time report increased positive affect and decreased negative affect following the practice; this effect remained for as much as one week following the initial mindfulness practice. Across a variety of studies, researchers have found that mindfulness training (whether it be through mindful breathing, body scan, MBSR, MBCT, and/or an intensive mindfulness retreat) can increase positive affect and decrease negative affect. This effect is seen for both short-term (e.g., two to three days) and long-term (e.g., eight to nine weeks) training across different populations (e.g., clinical, non-clinical). The various approaches to — and time length of — mindfulness training shown in the studies above may support further exploration of immediate impacts of training for shorter sessions.

Improving cognitive performance. Mindfulness-based training may improve an individuals' cognitive functioning and performance on cognitive tasks, such as tasks that require individuals to retain and/or manipulate new information (Chambers et al., 2008; Mrazek et al., 2013; Zeidan et al., 2010). Activation of the prefrontal cortex is related to enhanced executive processing which helps individuals stay focused on the current task and manipulate new information (Tang et al., 2015). In a recent study on college-age students, Mrazek and colleagues (2013) assessed 48 undergraduate students randomly assigned to either a mindfulness class or nutrition class (control condition). The

researchers were interested in examining the effectiveness of these classes in terms of helping participants to improve their working memory capacity (WMC) as well as scores on the reading-comprehension section of a GRE practice test. In this study, the mindfulness class focused on learning the physical posture and the mental strategies involved in mindful meditation. More specifically, participants learned to focus on their breath to anchor the self to the present, to let go of passing thoughts, to reframe worries about the past, and to view the future as mental projections. In comparison, the participants in the nutrition class spent an equal amount of time learning nutrition basics, such as food science and strategies for eating healthy in addition to logging food intake without making any dietary changes. To include a WMC measure, the researchers used an automatic operation span task (OSPAN; Unsworth, Heitz, Schrock, & Engle, 2005).

The OSPAN task has been used in numerous studies to measure WMC performance within a variety of contexts (Brewin & Smart, 2005; Sanbonmatsu, Strayer, Medeiros-Ward, & Watson, 2013; Unsworth et al., 2005; Watson & Strayer, 2010). The OSPAN task shows a series of letters for 250 milliseconds that the participants are required to memorize. During this memorization process, the participants are also instructed to complete math problems between each letter. This task and procedure requires the participants to memorize three to seven letters and to store these letters in their working memory while simultaneously switching tasks to complete math problems. At the end of the series of presented letters, the participants must choose the letters that they viewed in the correct order sequence from a group of twelve letters (Mrazek et al., 2013; Unsworth et al., 2005).

Prior to the intervention classes (either the mindfulness or nutrition training), the researchers noted that there were no significant differences in terms of participants' performance levels on the OSPAN task as well as no statistical difference in terms of the participants' scores on a practice GRE reading-comprehension task. However, after two weeks of the intervention classes (completed four days a week for 45 minutes per session), the researchers found that participants in the mindfulness training condition improved their scores on the OSPAN task and GRE reading-comprehension practice test by 16 percentile points compared to the nutrition class.

In addition, follow-up analyses suggested that participants in the mindfulness training class reported decreased mind wandering compared to participants in the nutrition class condition (Mrazek et al., 2013). This findings of decreased mind wandering may be related to previous research that shows mindfulness training reduces activation of the default network; the default network includes a collection of brain regions associated with markers of mind wandering (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009; Tang et al., 2009). Overall, the findings of this study indicate that college-age students may experience improvements in their cognitive performance after mindfulness training. The findings in this study support the hypothesis that by practicing mindfulness, college-age students may experience benefits in academic tasks (e.g., tasks in class or on exams that require processing multiple pieces of information or taking in new information for understanding). Students who may be stressed or anxious about the expectations of performance in college may be more inclined to engage in these practices with the hope of improving academic performance.

The research described above collectively indicates there may be a positive interaction of mindfulness training and participants' ability to complete tasks that require working memory and executive functioning. Overall, the more a person practices mindfulness, the more benefits might be seen; however, research has not yet explored how practicing mindfulness for a shorter time (e.g., three to five minutes) might impact cognitive performance among college-age students.

Summary of the Current Study

The research detailed above collectively supports that engaging in mindfulness over a prolonged period of time has a positive impact on the selected variables of interest. The longer individuals engage in mindfulness-based practices, the more effective the strategies are at enhancing positive changes in things like mood and attention/awareness. However, previous research has minimally examined the immediate effect of practicing mindfulness strategies for a short period of time. Moreover, previous research has mainly utilized an in-person trained guide or a researcher with expertise and knowledge of mindfulness to lead individuals through a mindfulness practice. The current study examined how the practice of mindfulness relates to a variety of outcomes, namely attention and awareness, depression, anxiety, stress, affect, and cognitive performance. Because college students are a unique subset of the population who might benefit from mindfulness practices, the current study examined the effectiveness of a mobile-phone mindfulness application for this population of interest. Participants came to the lab at the beginning of the week (Monday) for an initial lab session (Time 1), practiced the strategy on their own guided by the mobile-phone application during the week (Tuesday through

Thursday), and came back to the lab at the end of the week (Friday) for a final lab session (Time 2).

Hypotheses

Contributions of the current study include attempts to address some of the prior limitations in previous research associated with the accessibility of mindfulness training and the length of training sessions needed to see benefits. The two mindfulness strategies (i.e., mindful breathing and a body scan) also were compared for levels of effectiveness. In accordance with previous research, the following hypotheses were developed.

Hypothesis one. Participants in the mindful breathing and body scan conditions compared to the control condition will show improvements in attention and awareness from Time 1 (initial lab session) to Time 2 (final lab session).

Hypothesis two. Participants in the mindful breathing and body scan conditions compared to the control condition will show decreases in depression, anxiety, and stress from Time 1 to Time 2.

Hypothesis three. Participants in the mindful breathing and body scan conditions compared to the control condition will show increases in positive affect and decreases in negative affect from Time 1 to Time 2.

Hypothesis four. Participants in the mindful breathing and body scan conditions compared to the control condition will show improvements in cognitive performance from Time 1 to Time 2.

Research Question. Is one mindfulness strategy (mindful breathing or body scan) more effective than the other at impacting these variables of interest?

METHOD

Participants

Participants were recruited from general education classes at a small Midwestern university. Participants who completed the study earned research (or extra) credit to fulfill a course requirement. However, participation in this research was voluntary; alternative options, such as writing a research analysis paper were offered to students who decided not to participate in the current study. To complete the study participants were required to either have access to a mobile-phone, iPad/tablet, or laptop computer to access the mindfulness application. All participants were treated in accordance with American Psychological Association standards for ethical treatment (American Psychological Association, 2017). Participants were given an informed consent prior to starting the study and debriefing at the conclusion of the study.

Ninety-four participants completed the initial measures (Time 1). However, seventeen cases were removed and not included in the data analyses that follow because these participants did not return for the final lab session (Time 2). Three cases also were removed and not included in the analyses that follow due to the participants not being at least 18 years old. Overall, 74 participants completed the current study (25 males and 49 females) with an age range of 18-40 (M_{age} = 19.14, SD_{age} = 2.61). The majority of the participants self-identified as White/Caucasian (79.7%), followed by Hispanic/Latino(a) (12.2%), Other (4.1%), African-American/Black (2.7%), and Asian/Pacific Islander (1.4%). A majority were classified as freshman (70.3%), followed by sophomore (18.9%), junior (9.5%) and senior (1.4%) class standing. There were 27 participants in

each experimental condition (i.e., Mindful Breathing, Body Scan) and 20 participants in the control condition.

Materials

***Smiling Mind* mobile phone application.** Both mindfulness-based conditions utilized the phone application, "*Smiling Mind*." This is a mobile phone application that educates individuals on mindfulness and guides individuals through different mindfulness strategies (Mani et al., 2015). Participants were given written instructions on how to access the application, how to create an account, and how to navigate the mobile application to use when asked to practice on their own outside of the lab. After this introduction to the application, participants were instructed to listen to and complete either a short breathing exercise, (i.e., "Exploring the breath," if in the mindful breathing condition) or a short body scan exercise (i.e., "One-minute body scan" if in the body scan condition).

Exploring the breath. Participants in the mindful breathing condition used the "Exploring the Breath" session (one minute, 26 seconds); this session guided participants through approximately one-and-a-half minutes of focused breathing. This session, known as a "bite size" session, was intended to guide participants to focus on the present moment by anchoring their focus and attention to their breath.

One-minute body scan. Participants in the body scan condition used the program "One Minute Body Scan," (one minute, 19 seconds). The body scan began with attention focused on the toes, then moved through various areas of the body until attention reached the top of the head. This "bite size" session guided participants to pay close attention to any stress or tension held in different areas of the body. This session also instructed

participants to check on how their body was functioning and scan for any areas of ailment within the body.

Mindfulness Attention Awareness Scale (MAAS). Participants completed the MAAS (Brown & Ryan, 2003), a 15-item survey about day-to-day experiences pertaining to mindfulness, attention, and awareness (see Appendix A). The MAAS has been widely used in previous research related to mindfulness practices and considered to be a reliable and valid measure (Brown & Ryan, 2003; Chambers et al., 2008; Deyo et al., 2009; LePera, 2011; Shapiro et al., 2008). In the current study, items on the MAAS contained good internal consistency (α_{Time1} = .85; α_{Time2} = .89).

An example from the MAAS includes: "I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there." Fifteen items were measured on a 6-point Likert-type scale (1= Almost Always; 6= Almost Never). These items were averaged to create a total MAAS score with higher scores indicating better mindfulness, attention, and awareness. Overall, MAAS scores were compared from Time 1 (initial lab session) to Time 2 (final lab session) for each participant, as well as between the three conditions (i.e., mindful breathing; body scan; control).

Depression Anxiety and Stress Scale – 21 (DASS-21). Participants also completed the DASS-21, a shortened version of the original DASS (Lovibond & Lovibond, 1995) to measure current symptoms of depression, anxiety, and stress (see Appendix B). Previous research using this scale has found it to be reliable and valid (Lovibond & Lovibond, 1995; Osman et al., 2012). For each subscale, items on the DASS-21 contained good internal consistency: Depression (α_{Time1} = .86; α_{Time2} = .88); Anxiety (α_{Time1} = .67; α_{Time2} = .66); Stress (α_{Time1} = .69; α_{Time2} = .79).

Twenty-one items were used (seven items per subscale). Items were measured on a 4-point Likert-type scale (0 = Did not apply to me at all; 3 = Applied to me very much, or most of the time). An example from the questionnaire related to depression includes: "I found it difficult to work up the initiative to do things." An example from the questionnaire related to anxiety includes: "I was worried about situations in which I might panic and make a fool of myself." Finally, an example from the questionnaire related to stress includes: "I tend to over-react to situations." A composite score was created for each subscale by averaging the corresponding items. Higher scores indicate greater levels of depression, anxiety, and/or stress. Scores for each subscale on the DASS-21 were compared from Time 1 (initial lab session) to Time 2 (final lab session), as well as between the three conditions.

Positive and Negative Affect Scale (PANAS). Participants completed the PANAS (Watson et al., 1988), a list comprised of 10 positive affect and 10 negative affect adjectives of current mood (see Appendix C). Similar to the scales described above, the PANAS has been used in previous research and is a valid and reliable measure (Schroevers & Brandsma, 2010). In the current study, there was good internal consistency of items used to measure positive affect (α_{Time1} = .87; α_{Time2} = .87) and negative affect (α_{Time1} = .87; α_{Time2} = .87).

Twenty items were measured on a 5-point Likert-type scale (1 = Very slightly or not at all; 5 = Extremely). Examples of some positive affect items include: "Excited," "strong," and "enthusiastic." Examples of some negative affect items include: "Afraid," "upset," and "guilty." Composite scores for positive affect and negative affect were generated by averaging the corresponding items. Higher scores on the positive affect

items indicated better/more positive mood; higher scores on the negative affect items indicated less positive/more negative mood. Scores for positive affect and negative affect were compared from Time 1 to Time 2, as well as between the three conditions.

Operation Span Task (OSPAN). In the initial and final sessions (Time 1 and Time 2), participants completed the OSPAN Task (Unsworth et al., 2005), a series of switch-tasks that require flow of working memory skills. The task required participants to remember a series of presented letters in their working memory while completing simple math problems between letter presentations. Each participant completed 15 trials total. The trials were split into three equal groupings (five trials per grouping). Each grouping had one trial of three letters, one trial of four letters, one trial of five letters, one trial of six letters, and one trial of seven letters presented. It is important to note that the order of trails was randomized in each grouping. Participants' performance was scored on how many letters they chose correctly in each trial (i.e., a trial of four letters equates to four points). Higher scores indicate better performance on the task. Scores ranged from zero (no letters correct in the 15 trials) to 75 (all letters correct in the 15 trials). Performance on the task was compared from Time 1 to Time 2, as well as between the three conditions.

Manipulation check questions. Participants also completed a series of manipulation check questions during the initial and final lab sessions. Participants were asked whether or not they had any prior exposure to mindfulness practices; followed by "If yes, which mindfulness strategies have you practiced?" During the final lab session, participants in the mindfulness conditions also were asked questions to assess if they understood what they were being asked to do outside of the lab and if they complied with

the researcher's instructions: "To what extent do you feel the instructions provided were clear enough for you to understand what you were being asked to do?" (1 = not at all, 5 = great extent) and "To what extent did you follow the instructions?" (1 = not at all, 5 = great extent). See Appendix E for a full list of questions.

Descriptive information about the assigned strategy. During the final lab session, participants in either mindfulness condition responded to eight statements regarding their perception of the strategy they were assigned (see Appendix E). Statements in this final lab session survey related to their experience of practicing the technique (e.g., "I felt awkward while practicing the assigned strategy") on a 5-point scale from "Strongly Disagree" to "Strongly Agree." Other statements included the participants rating the likelihood of using the assigned strategy in the future, in addition to the degree to which they perceived the strategy impacted the variables of interest (attention/awareness, mood, stress, and the cognitive task).

Procedure

The primary researcher asked instructors of general education classes to announce this research opportunity to their students (see Appendix F). Participants voluntarily signed up for a time to complete the study in a research lab housed within the Psychology Department. Participants were randomly assigned to either the mindful breathing condition, the body scan condition, or a control condition (participants in this condition did not learn a mindfulness strategy). All participants within one time slot were assigned to the same condition, and time slots were set up for groups of one to four participants.

When participants came to the lab for their initial session (Time 1), they read an informed consent which included a summary of the experiment and what participants

would be asked to do (see Appendix G). The informed consent stressed the voluntary and confidential nature of the study. To compare Time 1 and Time 2 scores, participants were assigned a unique ID number by the primary researcher. This ID number (and not the participants' name) were used to match survey scores and OSPAN task scores for each participant during the initial lab session (Time 1) and final lab session (Time 2). Only the primary researcher and thesis advisor had access to the ID number list, and the list was kept in a secure location (locked room in Martin Allen Hall). After reading the consent, participants were given an opportunity to ask questions. If participants chose to participate, they indicated consent on Survey Monkey by typing in their ID number and clicking "Next." After clicking "Next," participants completed a short demographics questionnaire (see Appendix D), followed by the MAAS, the DASS-21, and the PANAS – these questionnaires were counterbalanced in an effort to reduce any potential order bias. Participants also completed the OSPAN task on the computer provided in the lab.

The researcher instructed participants in the mindful breathing and body scan conditions to download the "*Smiling Mind*" application. Participants were taught how to use the program for their assigned strategy, and then completed the strategy together as a group in the lab. Participants in the control condition did not download the "*Smiling Mind*" application. Instead, participants were asked to sit quietly while the researcher prepared for the next part of the study. Participants in this condition sat quietly for a similar amount of time as the mindful breathing and body scan conditions. The control condition was designed to be consistent with prior research testing the effectiveness of mindfulness-based strategies (Jeter & Brannon, 2017).

After downloading the application and practicing the assigned technique, participants were instructed that over the next three days they would receive an email reminding them to practice the assigned strategy (if in the mindful breathing or body scan condition). Participants also were told that during the final lab session, the primary researcher would ask to see their "*Smiling Mind"* dashboard; the dashboard tracks practice times each day over a period of one week, and this was used to assess if the participants practiced over the three day period like they were instructed. Participants in the control condition did not receive these instructions or emails from the primary researcher during the three days between the initial and final lab sessions. Finally, participants signed up for their final lab session before being excused.

Over the next three days following the initial session, participants received an email from the researcher reminding them to practice the assigned strategy; participants in the control condition did not receive an email. On the third day, all participants received a reminder email to come back to the lab for their final session. During the final lab session (Time 2), participants in the mindful breathing condition and body scan condition were asked to show their *Smiling Mind* dashboard. Participants who did not complete the three-days of training were not included in the analyses that follow. Next, participants practiced the assigned strategy one last time in the lab. Following this practice, participants completed the three surveys from the initial lab session — MAAS, DASS-21, and PANAS in counterbalanced order — and the OSPAN task. Participants in the control condition also came to the lab; however, they were asked to sit quietly for a similar amount of time that it took participants in the mindful breathing and body scan conditions to complete the strategy. Participants in the control condition then completed

the three surveys and the OSPAN task. After all participants completed the OSPAN task, the researcher debriefed the participants and thanked them for their participation (see Appendix H).

Design

The independent variables for the current study included the presence of a mindfulness-based strategy (i.e., the effect of either a mindfulness breathing condition, body scan condition, or no-strategy control condition) and time (Time 1 and Time 2). Condition was treated as a between subjects variable and time was treated as a within subjects variable. The dependent variables included the self-reported scores on the MAAS, DASS-21, and PANAS, along with the absolute score on the OSPAN task. Overall, mixed-factors ANOVAs were used to examine the effect of condition (between subjects) and time (within subjects) on the dependent variables of interest.

RESULTS

Data Cleaning and Descriptive Information

The data were assessed for missing cases for each variable of interest. If participants were missing one response for a variable, the mean value was calculated and inserted in place of the missing response (Tabachnick & Fidell, 2013). Overall, seventy-four participants were used in the final data analyses. A preliminary analysis of the data revealed that all variables were normally distributed and considered approximately normal in relation to skewness and kurtosis.

Time 1 descriptive information. To assess whether there were differences between the conditions on the dependent variables of interest, a series of one-way between subjects ANOVAs were used to compare scores during the initial lab session (Time 1). Participants completed a series of surveys at the beginning of the initial lab session; however, scores on these measures did not differ significantly across the conditions. The variables assessed included: mindfulness, attention, and awareness [$F(2, 72) = 1.44$, $p = .24$], depression [$F(2, 73) = 0.21$, $p = .81$], anxiety [$F(2, 73) = 0.15$, $p = .86$], stress [$F(2, 73) = 0.10$, $p = .90$], positive [$F(2, 73) = 1.22$, $p = .30$] and negative [$F(2, 73) = 0.47$, $p = .63$] affect, and the automatic operation span task [$F(2, 73) = 1.46$, $p = .24$].

Time 2 descriptive information. During the final lab session (Time 2), all participants were asked whether or not they had previous experience engaging in a mindfulness strategy. Fourteen participants reported having previous experience (selected yes) practicing mindfulness through one or more methods (e.g., mindful breathing [$N = 11$], body scan [$N = 2$], yoga [$N = 11$], mindful eating [$N = 5$], lovingkindness [$N = 5$],

and/or mantra [N = 1]). However, the majority of the sample reported no prior experience with a mindful practice.

Participants who were assigned to the mindful breathing (N = 27) or body scan (N = 27) conditions were asked to answer a series of questions regarding the clarity of the instructions they were provided when learning the assigned mindfulness strategy and their adherence to those instructions. In assessing the clarity of instructions provided, participants were asked to respond on a scale of one ("Not at all clear") to five ("Clear to a great extent"). An independent samples *t*-test indicated that there was not a significant difference between the mindfulness conditions [$t(52) = -1.08$, $p = .29$]. Participants in the mindful breathing (M = 4.48, SD = .70) and body scan (M = 4.67, SD = .55) conditions rated the clarity of instructions similarly, and these findings suggest that participants understood what they were being asked to do during the study. Participants also were asked about the extent to which they followed directions, measured on a scale of one ("Not at all") to five ("Followed instructions to a great extent"). An independent samples *t*-test indicated that there was not a significant difference between the mindfulness conditions [$t(52) = -.86$, $p = .40$]. Participants in the mindful breathing (M = 4.37, SD = .63) and body scan (M = 4.52, SD = .64) conditions followed the directions provided.

Further, participants assigned to either the mindful breathing or body scan conditions were asked about their experience practicing the assigned mindfulness strategy and their perceptions of the strategy's effectiveness. Participants in the mindfulness conditions responded to eight statements about the experience of practicing the assigned strategy. Responses to the eight survey items were rated on a one ("Strongly disagree") to five ("Strongly Agree") scale. First, participants responded to, "I felt awkward while

practicing the assigned strategy." There was not a significant difference between participants' perceptions of feeling awkward while practicing the mindful breathing (M = 2.74, SD = 1.26) or body scan (M = 2.48, SD = .89) strategy [$t(52) = 0.87$, $p = .39$]. Participants' scores on this item were approximately at the mid-point of the scale, thus indicating that they felt neutral (neither agree nor disagree) about the awkwardness of practicing the strategy. Second, participants responded to, "This is a strategy I will practice in the future." There was not a significant difference between participants in the mindful breathing (M = 3.52, SD = .89) and body scan (M = 3.33, SD = .92) conditions in terms of their likelihood to use the strategy in the future [$t(52) = 0.75$, $p = .46$]. The mean scores on this item were above the midpoint of the scale, potentially indicating that participants may continue to practice the assigned strategy in the future. Next, participants responded to, "I enjoyed practicing the mindfulness strategy." Participants in the mindful breathing (M = 3.81, SD = .79) and body scan (M = 3.81, SD = .79) conditions reported similar scores of enjoying the strategy they practiced [$t(52) = -0.19$, $p = .85$]. Similarly, participants responded to, "I am glad I practiced the mindfulness strategy." Participants in the mindful breathing (M = 3.89, SD = .64) and body scan (M = 4.08, SD = .63) conditions reported similar scores for being glad they practiced the strategy [$t(51) = -1.08$, $p = .29$] although scores did not differ by condition (see Figure 1).

Next, participants responded to, "Practicing the mindfulness strategy decreased my stress level(s)." There was not a significant difference between the mindful breathing (M = 3.44, SD = .70) and body scan (M = 3.56, SD = .97) condition [$t(52) = -0.48$, $p = .63$]. Participants tended to agree that practicing the strategy decreased stress levels; however, it should be noted that the mean scores were only slightly (1-point) above the

midpoint of the scale. The next statement was, "Practicing the mindfulness strategy improved my mood." Participants in the mindful breathing (M = 3.52, SD = .89) and body scan (M = 3.63, SD = .63) conditions reported similar scores [$t(52) = -0.53$, $p = .60$;] however, scores did not differ by condition. Participants responded to, "Practicing the mindfulness strategy improved my attention and awareness." Those in the mindful breathing (M = 3.63, SD = .79) condition reported similar scores as participants in the body scan (M = 3.33, SD = .83) condition on this item as well [$t(52) = 1.34$, $p = .19$]. Finally, participants responded to the statement, "Practicing the mindfulness strategy helped me to perform better on the cognitive task done in the lab." Results suggest no significant differences in perceptions of helpfulness on the OSPAN task [$t(52) = -0.13$, $p = .90$]. Participants in the mindful breathing (M = 3.67, SD = 1.04) and body scan (M = 3.70, SD = 1.10) conditions perceived the strategy as helpful to the same degree; however, it should again be noted that the mean score was only slightly above the mid-point of the scale (see Figure 2).

Finally, all participants (including the control condition) answered questions about perceived stress levels for the week they completed the study compared to other weeks, as well as any positive and/or negative events that may have occurred during the week. Participants were asked to rate how busy/stressful the week was for them (e.g., information relevant to social events, classes, exams, etc.) compared to other weeks. This was done on a scale of one ("Less busy week compared to other weeks") to five ("Busier week compared to other weeks"). Accordingly, a three on the scale indicated a "typical week." A one-way between subjects ANOVA indicated that here was not a significant difference between the conditions [$F(2, 73) = 0.25$, $p = .78$]. Participants in the mindful

breathing condition (M = 3.67, SD = .83), body scan (M = 3.70, SD = 1.03) and control condition (M = 3.85, SD = .81) reported that the week they completed the study was only slightly busier than a typical week.

Participants in all three conditions also were asked about the stress level of the week compared to a "typical" week on a scale of one ("not stressed") to ten ("extremely stressed"). A one-way ANOVA indicated there was not a significant difference between the conditions [$F(2, 73) = 1.55$, $p = .22$]. Participants in the mindful breathing condition (M = 5.89, SD = 2.36), body scan (M = 5.70, SD = 1.98) and control condition (M = 6.75, SD = 1.89) all considered the week to be mostly average in terms of stress-level.

Main Analyses

For each hypothesis tested below, mixed-factors ANOVAs were performed. Tukey post-hoc tests were used for all analyses.[1]

Hypothesis one: Mindfulness, attention, and awareness. To test the first hypothesis, a mixed factors ANOVA was conducted to examine the impact of the condition (i.e., mindful breathing, body scan, or control) and time (Time 1 and Time 2) on mindfulness, attention, and awareness scores. It was hypothesized that participants in the mindful breathing and body scan conditions would report increased levels of mindfulness, attention, and awareness from Time 1 (initial lab session) to Time 2 (final lab session) compared to the control group. Results indicate that there was not a

[1] For each main analysis to test the established hypotheses, time and condition were used to assess differences for each dependent variable of interest. Given that some participants had prior experience practicing a mindful strategy before the study, analyses were performed using prior experience, time, and condition to test for differences regarding the variables of interest. The results when including prior experience were the same as the main analyses used to test each hypothesis (i.e., only examining condition and time) in terms of the pattern of significance for each dependent variable.

significant main effect of time [$F(1, 68) = 0.39$, $p = .39$; partial $\eta^2 = .01$] as well as not a significant main effect of condition [$F(2, 68) = 0.83$, $p = .44$; partial $\eta^2 = .02$]. There also was not a significant interaction between time and condition [$F(2, 68) = 0.48$, $p = .62$; partial $\eta^2 = .01$] in regards to participants' self-reported rating of mindfulness awareness, and attention.

Participants in the mindful breathing condition did not significantly differ in their mindfulness, awareness, and attention ratings from Time 1 ($M = 3.67$, $SD = .63$) to Time 2 ($M = 3.79$, $SD = .76$) compared to participants in the body scan condition ($M_{Time1} = 3.97$, $SD = .73$; $M_{Time2} = 3.97$, $SD = .69$) and control condition ($M_{Time1} = 3.96$, $SD = .90$; $M_{Time2} = 3.96$, $SD = 1.03$). The body scan and control condition scores also did not significantly differ. See Table 1 for a complete list of descriptive information.

Hypothesis two: Depression, anxiety, and stress. The second hypothesis was tested through a series of mixed factors ANOVAs to examine the impact of a mindfulness strategy and time on self-reported depression, anxiety, and stress symptoms, respectively. It was hypothesized that participants in the mindful breathing and body scan conditions would report lower levels of depression, anxiety, and stress from Time 1 to Time 2 compared to the control group. See Table 2 for a complete list of descriptive information.

Depression. The results suggest that there was neither a significant main effect of time [$F(1, 68) = 0.46$, $p = .50$; partial $\eta^2 = .01$] nor significant main effect of condition [$F(2, 68) = 0.25$, $p = .78$; partial $\eta^2 = .01$]. The interaction between time and condition also was non-significant [$F(2, 68) = 0.51$, $p = .61$; partial $\eta^2 = .02$]. Participants in the mindful breathing condition did not differ significantly in their depression rating from Time 1 ($M = 1.68$, $SD = .58$) to Time 2 ($M = 1.66$, $SD = .62$) compared to participants in

the body scan condition (M_{Time1} = 1.61, *SD* = .49; M_{Time2} = 1.54, *SD* = .42) and control condition (M_{Time1} = 1.64, *SD* = .40; M_{Time2} = 1.65, *SD* = .46). The body scan and control condition also did not significantly differ.

Anxiety. Similarly, the main effect of time [$F(1, 68) = 0.23$, $p = .64$; partial $\eta^2 = .00$] and condition [$F(2, 68) = 0.29$, $p = .75$; partial $\eta^2 = .01$] were non-significant. An interaction between time and condition for self-reported anxiety scores was not found [$F(2, 68) = 1.15$, $p = .32$; partial $\eta^2 = .03$]. Scores reported for anxiety did not differ significantly for the mindful breathing condition from Time 1 (*M* = 1.88, *SD* = .53) to Time 2 (*M* = 1.79, *SD* = .45) compared to the body scan (M_{Time1} = 1.82, *SD* = .39; M_{Time2} = 1.79, *SD* = .38) and control group (M_{Time1} = 1.87, *SD* = .55; M_{Time2} = 1.94, *SD* = .58). The body scan and control condition also did not significantly differ.

Stress. Finally, results were similar for self-reported levels of stress. The main effect of time [$F(1, 68) = 0.68$ $p = .41$; partial $\eta^2 = .01$], the main effect of condition [$F(2, 68) = 0.04$ $p = .96$; partial $\eta^2 = .00$], and the interaction of time and condition [$F(2, 68) = 0.01$, $p = .99$; partial $\eta^2 = .00$] were non-significant. Self-reported stress scores for participants in the mindful breathing group did not differ significantly from Time 1 (*M* = 2.05, *SD* = .43) to Time 2 (*M* = 2.02, *SD* = .42) compared to the body scan condition (M_{Time1} = 2.04, *SD* = .26; M_{Time2} = 2.02, *SD* = .36) and control condition (M_{Time1}= 2.08, *SD* = .52; M_{Time2} = 2.05, *SD* = .58). The body scan and control condition also did not significantly differ.

Hypothesis three: Positive and negative affect. To test the third hypothesis, two mixed factors ANOVAs were conducted to examine the impact of condition and time on self-reported positive and negative affect. It was hypothesized that participants in the

mindful breathing and control conditions would report more positive affect (less negative affect) from Time 1 to Time 2 compared to the control condition. See Table 3 for a complete list of descriptive information.

Positive affect. Results suggest that the main effect of time [$F(1, 68) = 0.92$, $p = .34$; partial $\eta^2 = .01$], main effect of condition [$F(2, 68) = 1.73$, $p = .18$; partial $\eta^2 = .05$], and the interaction [$F(2, 68) = 0.51$, $p = .61$; partial $\eta^2 = .02$] were not significant. Participants in the mindful breathing condition did not differ significantly in reported positive affect ratings from Time 1 ($M = 3.33$, $SD = .59$) to Time 2 ($M = 3.30$, $SD = .67$) compared to the body scan ($M_{Time1} = 2.98$, $SD = .72$; $M_{Time2} = 3.11$, $SD = .53$) and control conditions ($M_{Time1} = 3.22$, $SD = .78$; $M_{Time2} = 3.37$, $SD = .77$). The body scan and control condition also did not significantly differ.

Negative affect. In contrast, results did indicate that there was a significant main effect of time on self-reported negative affect [$F(1, 68) = 6.43$, $p = .01$; partial $\eta^2 = .09$]. Participants negative affect scores slightly increased from Time 1 ($M = 1.58$, $SD = .56$) to Time 2 ($M = 1.72$, $SD = .62$). However, there was not a significant main effect of condition [$F(2, 68) = 0.27$, $p = .77$; partial $\eta^2 = .01$] and interaction [$F(2, 68) = 0.05$, $p = .95$; partial $\eta^2 = .00$]. Overall, participants in the mindful breathing condition did not differ in their scores of negative affect from Time 1 ($M = 1.64$, $SD = .62$) to Time 2 ($M = 1.76$, $SD = .65$) compared to the body scan condition ($M_{Time1} = 1.52$, $SD = .45$; $M_{Time2} = 1.66$, $SD = .60$) and control condition ($M_{Time1} = 1.58$, $SD = .62$; $M_{Time2} = 1.73$, $SD = .63$). The body scan and control condition also did not significantly differ.

Hypothesis four: Cognitive performance. The fourth hypothesis was tested through a mixed factors ANOVA to examine the impact of condition and time on

participants' performance on the automated operation span task (OSPAN; Unsworth et al., 2005). It was hypothesized that participants' scores on the OSPAN task would increase from Time 1 to Time 2 for those in the mindful breathing and body scan conditions compared to the control condition. Results indicate that there was a significant main effect of time [$F(1, 70) = 8.39$, $p = .01$; partial $\eta^2 = .11$] on participants' absolute score on the OSPAN task. Scores on the OSPAN task did increase from Time 1 (M = 35.37, SD = 15.43) to Time 2 (M = 40.18, SD = 16.08). However, there was not a significant main effect of condition [$F(2, 70) = 1.28$, $p = .29$; partial $\eta^2 = .04$] or significant interaction [$F(2, 70) = 0.57$, $p = .39$; partial $\eta^2 = .03$].

Participants in the mindful breathing condition did not significantly differ in their absolute OSPAN score from Time 1 (M = 31.26, SD = 12.57) to Time 2 (M = 38.67, SD = 13.42) compared to the body scan condition (M_{Time1} = 39.04, SD = 16.21; M_{Time2} = 43.27, SD = 19.15) and control condition (M_{Time1} = 36.15, SD = 17.25; M_{Time2} = 38.20, SD = 15.18). The body scan and control condition also did not significantly differ. See Table 4 for the complete list of descriptive information.

Exploratory Analyses

Given the non-significant results found when testing the established hypotheses, some exploratory analyses to further examine the data were conducted. The focus was on the mindfulness, attention, and awareness scale to assess if scores on this scale (higher scores indicate more mindfulness, attention, and awareness) were related to the other dependent variables measured. A series of bivariate correlations were utilized to assess relationships between the mindfulness, attention, and awareness scores and the other dependent measures for Time 2 (the final lab session after participants had completed the

study).

The bivariate correlations indicate that mindfulness, attention, and awareness scores were negatively related to depression [$r(73) = -.33$, $p = .00$], anxiety [$r(73) = -.40$, $p = .00$], stress [$r(72) = -.62$, $p = .00$], and negative affect [$r(73) = -.32$, $p = .01$]. Further, there was a non-significant positive relationship between positive affect [$r(73) = 0.05$, $p = .70$] and the absolute score on the OSPAN task [$r(73) = 0.12$, $p = .33$]. These results suggest that there is a relationship between scoring higher on the mindfulness, attention, and awareness scale and most variables of interest. This finding is promising and is discussed further in the discussion section that follows.

DISCUSSION

The purpose of the current study was to examine how engaging in brief mindfulness practices guided by a mobile-phone application impact individuals' self-reported mindfulness, attention, and awareness, symptoms of depression, anxiety, and stress, positive and negative affect, and performance on a cognitive task (i.e., the OSPAN task). Previous research supports engaging in longer mindfulness practices for four or more weeks to improve these variables of interest (Chambers et al., 2008; Mrazek et al., 2013; Shapiro et al., 2008); however, minimal research has examined the immediate impacts of shorter practices led by a mobile-phone application rather than by an in-person guide. It was anticipated that participants in either mindfulness condition (i.e., mindful breathing or body scan) would report increases in mindfulness, attention, and awareness, positive affect, and performance on the OSPAN task compared to participants in the control condition. It was also anticipated that participants in either mindfulness condition would report decreases in depression, anxiety, stress, and negative affect compared to participants in the control condition. Overall, only partial support was found for two of the hypotheses.

Hypothesis one (testing the interaction effect of time and condition on mindfulness, attention, and awareness) and hypothesis two (testing the interaction effect of time and condition on depression, anxiety, and stress) were not supported in the current study. Results did not suggest a significant interaction effect of time and condition (as well as no significant main effects) for these dependent variables. Participants in either mindfulness condition were expected to improve on self-reported mindfulness, attention, and awareness from the initial to the final lab session. Previous

research supports that participants comparable to the current study benefit from engaging in mindfulness practices (Chambers et al., 2008; Shapiro et al., 2008); however, the current study did not find this result in relation to the mindfulness, attention, and awareness variable. Exploratory analyses provided further insight however (discussed below) about this variable and relations to other dependent variables measured.

When examining depression, anxiety, and stress it was expected that scores would decrease over time, namely for the participants in the mindful breathing and body scan conditions; however, this anticipated result was not found. Previous research that has used the DASS-21 (the scale used in the current study) to assess depression, anxiety, and stress among college-age students has commonly found that although college students do not generally report clinical-levels of depression, anxiety, and stress, they do report moderate to high levels (Beiter et al., 2015; Osman et al., 2012). On a 4-point Likert-type scale (rated as 0 to 3), college students generally report at or above the mid-point of the scale, especially when responding to the stress and anxiety items. As such, it was expected that participants would report similarly in terms of moderate to high levels of depression, anxiety, and stress. However, when assessing the scores for the current sample during the initial and final lab sessions (and by condition), it was found that participants were on average reporting low-levels of depression (M_{Time1} = 1.64; M_{Time2} = 1.62), low levels of anxiety (M_{Time1} = 1.86; M_{Time2} = 1.83), and low/moderate levels of stress (M_{Time1} = 2.05; M_{Time1} = 2.02). Although high or clinical levels of depression, anxiety, and stress were not anticipated among the current sample, it was surprising that students were not reporting higher scores on this measure. It is important to take into account the low-levels of depression, anxiety, and stress reported by participants during

the study. Given these low levels that were reported initially by participants, it may not matter if they practiced a mindfulness strategy (or not) for one week as they were already reporting not being depressed, anxious, or stressed. Importantly, participants did report that the week they completed the study was an average/typical week that was not highly stressful. In the future it might be advantageous to test the mindfulness strategies at a time when students would be prone to higher levels of stress and anxiety (and perhaps depression), for example, during finals week. If participants are experiencing depression, anxiety, and stress, then perhaps shorter practices of mindfulness would be beneficial.

Hypothesis three (testing the interaction effect of time and condition on positive and negative affect) was only partially supported. Although positive affect did not significantly change over time or across condition, a significant main effect of time on negative affect did emerge. From the initial lab session (Time 1) to the final lab session (Time 2), participants reported a slight increase in negative affect; this result was in the opposite direction of the original prediction. Over the course of five days, participants in all three conditions did not show a significant change in self-reported positive affect. In contrast, participants showed a significant increase in negative affect from Time 1 to Time 2, regardless of the condition they were randomly assigned. This finding is surprising and unexpected given it was anticipated that negative affect would decrease over time, namely for those participants who were in the mindful breathing and body scan conditions. However, it is important to note that similar to the scores on depression, anxiety, and stress, the average negative affect score for the initial lab session (regardless of condition) was low (M = 1.58). The average score for negative affect recorded during the final lab session also was low (M = 1.72). On a 5-point Likert scale, these means

suggest that participants were not reporting high-levels (or even moderate levels) of negative affect while completing the study. As a result, it would be impractical to assume that the condition would impact negative affect across time provided the low levels of negative affect that were reported initially (and then throughout the week long study). Even though a significant main effect of time on negative affect did emerge, this effect should be interpreted with caution given the low average rating at both time points.

The fourth hypothesis also was partially supported; there was a significant main effect of time on participants' absolute scores on the OSPAN task; however, there was not a main effect of time or significant interaction of time and condition. Absolute scores on the OSPAN task significantly increased from the initial lab session (Time 1) to final lab session (Time 2), regardless of condition. Based on previous research, it was expected that participants who practiced the mindful breathing or body scan strategy would perform better on the task requiring switching attention and maintaining novel information in their working memory (Mrazek et al., 2013). Participants scored similarly to other samples in previous research using the OSPAN task (Unsworth et al., 2005; Sanbonmatsu et al., 2015). Although the results revealed a slight increase for participants in the mindfulness conditions from Time 1 to Time 2, neither of the two conditions increased significantly more than the control condition.

Part of the increase in performance across the conditions could be due to a practice effect or participants knowing what the task entailed when completing it for a second time. Due to the randomized nature of the task and the difficulty of the task — the number of letters to remember presented in a series and the math problems that need to be solved — it is unlikely that there was a practice effect in terms of participants being able

to remember the answers and then answering the questions correctly. However, there may have been a practice effect in that participants knew what the task involved during the final lab session and that the task would be difficult; this practice and knowledge perhaps better prepared participants to complete the task during the final lab session.

Exploratory Analyses

The exploratory analyses showed preliminary support for the relationships anticipated between the variables of interest. Specifically, higher scores on mindfulness, attention, and awareness were significantly related to lower scores on depression, anxiety, stress, and negative affect. Although not significant, the analyses showed a positive relationship between scores on mindfulness, attention, and awareness and positive affect and on OSPAN absolute scores. The exploratory analyses helped to examine the relationships between the variables of interest in more depth. These results suggest that as participants reported being aware of their surroundings and able to pay attention to the present moment, they reported less symptoms associated with depression, and anxiety, and stress.

Given the low ratings of depression, anxiety, and stress experienced by participants in this sample, this relationship might provide some preliminary support that the practice of being mindful, remaining aware, and maintaining attention is related to decreased depression, anxiety, and stress symptoms. This relationship is supported by previous research (Baer, 2003; Kabat-Zinn, 2003) and suggests that continued research on this topic may be warranted. As mentioned previously, future research might benefit from testing the brief mindfulness strategies among young adults during a time when they feel particularly stressed, anxious, and perhaps depressed. For example, future research

might target students when they are completing finals week and/or after experiencing something stressful (e.g., a romantic break-up). Doing so also may help account for the limitation in the current study that participants reported low-levels of negative affect (in addition to low depression, anxiety, and stress). Perhaps targeting students during a stressful period will subsequently help with the scores reported on the affect scale. These preliminary results regarding the relationships between the variables of interest may support the continued practice of mindfulness to increase attention and awareness, and subsequent potential decreases in negative emotions and experiences.

In addition to the relationships assessed by the exploratory analysis, it also is important to note that participants who were randomly assigned to either the mindful breathing or body scan conditions were asked if they perceived the strategy to be helpful. Although participants' mean scores did not significantly change on the variables of interest from Time 1 to Time 2, participants in the mindful breathing and body scan conditions did report that they perceived the assigned strategy as being helpful in relation to managing feelings of stress, and perceived the strategy as being helpful for improving mood and attention/awareness. This result preliminary suggests that continued research on this topic and brief practices of mindfulness may be useful given that students liked performing the strategy and perceived it as being somewhat helpful.

Limitations and Future Research

Although the exploratory analyses provide some support for the usefulness of mindfulness, attention, and awareness, it is important to note limitations of the current research. First, the sample and sample size of the current research may serve as a limitation. The sample size used for the main analyses was small with less than 30

participants per condition. Although resources cite 20-25 participants as adequate (Tabachnick & Fidell, 2013), perhaps a larger sample size would be beneficial. In addition to the sample size, the students who completed the study were not particularly diverse in age, sex, and ethnicity. This sample represents a typical college-age sample; however, results may not be generalizable to the broader population, and conclusions (about the significant results) must be drawn cautiously.

Second, the sample in the current study scored higher on what might be deemed as positive measures (e.g., positive affect items), and lower on negative measures (e.g., depression, anxiety, stress, and negative affect items) than expected. These low (or high) scores might account for the non-significant findings. That is, participants reported not experiencing depression, anxiety, stress, and negative affect throughout the entire study, and as a result, the mindfulness manipulations may not have been seen as being useful given these low scores. Mentioned previously, future research might benefit from conducting a similar study to test brief mindfulness strategies during a time when students report being stressed/anxious/depressed.

Third, the use of the brief practice among novices of a mindfulness practice may be a limitation. Previous research supports that longer practices are necessary for mastery (Kabat-Zinn, 1990; Kabat-Zinn, 2003; Langer & Moldoveanu, 2000); thus, it may be necessary for novice participants to learn the strategy through a longer practice before moving to the shorter sessions. The sample in the current study indicated that a majority of participants had either limited or no prior exposure to a mindfulness strategy before the study. Given the limited practice and exposure, future research might benefit from either testing the use of shorter/brief strategies for people who have exposure and have

practiced mindfulness in the past or using the brief strategy over a longer period of time (e.g., four weeks) after participants have more time to utilize the strategy in their daily routine. It also may be beneficial to examine how utilizing a longer initial session to better train participants to use the strategy correctly before engaging in shorter practices guided by the mobile application.

An additional limitation may involve only examining two mindfulness practices, a mindful breathing practice and body scan practice. Future research might consider examining other mindfulness-based strategies and how using one strategy versus a combination of strategies impacts the variables of interest over time. Finally, the use of a mobile-phone application to guide participants through the mindfulness practices may be a limitation of the current work. More research is needed for evaluating the quality of engagement in practice while listening to a recorded voice on the mobile-phone application compared to an in-person guide (Mani et al., 2015). College-age students use cell phones for social interactions, coordination with other individuals, and even time management (Aoki & Downes, 2003). If, during the practice guided by the mobile-phone application, the participants' phone rang for a social reason and/or notification, the participants may have been distracted from the task whereas when guided in-person, the participants may not have their phone out. Furthermore, it might be easier for participants to lose focus when practicing alone rather than with one or more other individuals (i.e., a guided group mindfulness practice) who may keep the participants accountable for fully engaging in the strategy.

Despite these limitations, this research provides information on the relationship between mindfulness and several areas of an individual's daily experiences. Participants

reported feeling like the mindfulness strategy they were assigned was a benefit, which may support the likelihood of the participants continuing to engage in the practice over time. It is important to understand how shorter, more accessible mindfulness strategies impact an individual's daily functioning. College students are especially important to focus on in regards to mindfulness research as they are a unique population who many benefit from the shorter practices most. Although most of the findings of the current study were either non-significant or unexpected in terms of the mindful breathing and body scan techniques used, the analyses showed that mindfulness, attention, and awareness (measured by the MAAS) was related to decreased depression, anxiety, stress, and negative affect. This result (in combination with prior research) provides some preliminary support that continued research on this topic may be important. Overall, more research is needed to better understand the benefits of brief mindfulness practices among college students.

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Table 1

Mean scores and standard deviations for mindfulness, attention, and awareness by time and condition

Condition	Initial MAAS	Final MAAS	Total
Mindful Breathing	3.67 *(.63)*	3.79 *(.76)*	3.73 (*.56)*
Body Scan	3.97 *(.73)*	3.97 *(.69)*	3.97 *(.65)*
Control	3.96 *(.90)*	3.96 *(1.03)*	3.96 *(.86)*
Total *(SD)*	3.86 *(.75)*	3.90 *(.81)*	

Table 2

Mean scores and standard deviations for depression, anxiety, and stress by time and condition

Condition	Initial Depression	Final Depression	Initial Anxiety	Final Anxiety	Initial Stress	Final Stress	Total Depression	Total Anxiety	Total Stress
Mindful Breathing	1.68 *(.58)*	1.66 *(.62)*	1.88 *(.53)*	1.79 *(.45)*	2.05 *(.43)*	2.02 *(.42)*	1.67 *(.56)*	1.84 *(.45)*	2.03 *(.40)*
Body Scan	1.61 *(.49)*	1.54 *(.42)*	1.82 *(.39)*	1.78 *(.38)*	2.04 *(.26)*	2.02 *(.36)*	1.58 *(.42)*	1.81 *(.33)*	2.03 *(.27)*
Control	1.64 *(.40)*	1.65 *(.46)*	1.87 *(.55)*	1.94 *(.58)*	2.08 *(.52)*	2.05 *(.58)*	1.64 *(.46)*	1.91 *(.49)*	2.06 *(.49)*
Total *(SD)*	1.64 *(.50)*	1.62 *(.51)*	1.86 *(.48)*	1.83 *(.47)*	2.05 *(.40)*	2.02 *(.44)*			

Table 3

Mean scores and standard deviations for positive and negative affect by time and condition

Condition	Initial Positive	Final Positive	Initial Negative	Final Negative	Total Positive	Total Negative
Mindful Breathing	3.33 *(.59)*	3.30 *(.67)*	1.64 *(.62)*	1.76 *(.65)*	3.32 *(.57)*	1.70 *(.64)*
Body Scan	2.98 *(.72)*	3.11 *(.53)*	1.52 *(.45)*	1.66 *(.60)*	3.05 *(.61)*	1.59 *(.47)*
Control	3.22 *(.78)*	3.37 *(.77)*	1.57 *(.62)*	1.73 *(.63)*	3.30 *(.62)*	1.66 *(.57)*
Total *(SD)*	3.18 *(.70)*	3.25 *(.65)*	1.58^{a} *(.56)*	1.72^{b} *(.62)*		

Note: Means in rows with different subscripts significantly differ from one another.

Table 4

Mean absolute scores and standard deviations for the OSPAN task by time and condition

Condition	Initial Absolute OSPAN	Final Absolute OSPAN	Total Absolute OSPAN
Mindful Breathing	31.26 *(12.57)*	38.67 *(13.42)*	34.96 (*11.44)*
Body Scan	39.04 *(16.21)*	43.27 *(19.15)*	41.15 *(16.30)*
Control	36.15 *(17.25)*	38.20 *(15.18)*	37.18 *(14.06)*
Total *(SD)*	35.37[a] *(15.43)*	40.18[b] *(16.08)*	

Note: Means in rows with different subscripts significantly differ from one another.

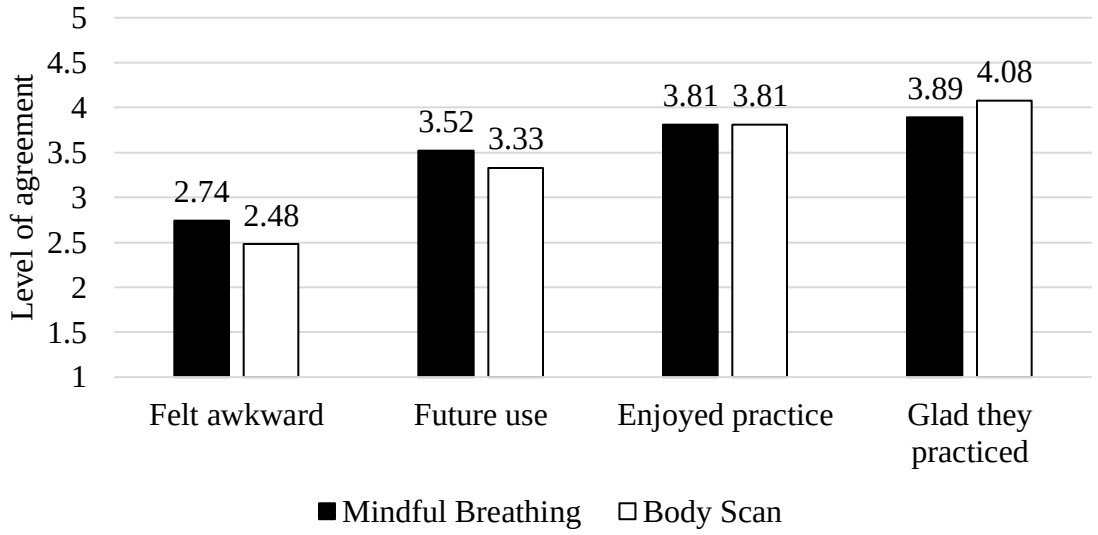

Figure 1. Perception of practice by mindfulness condition

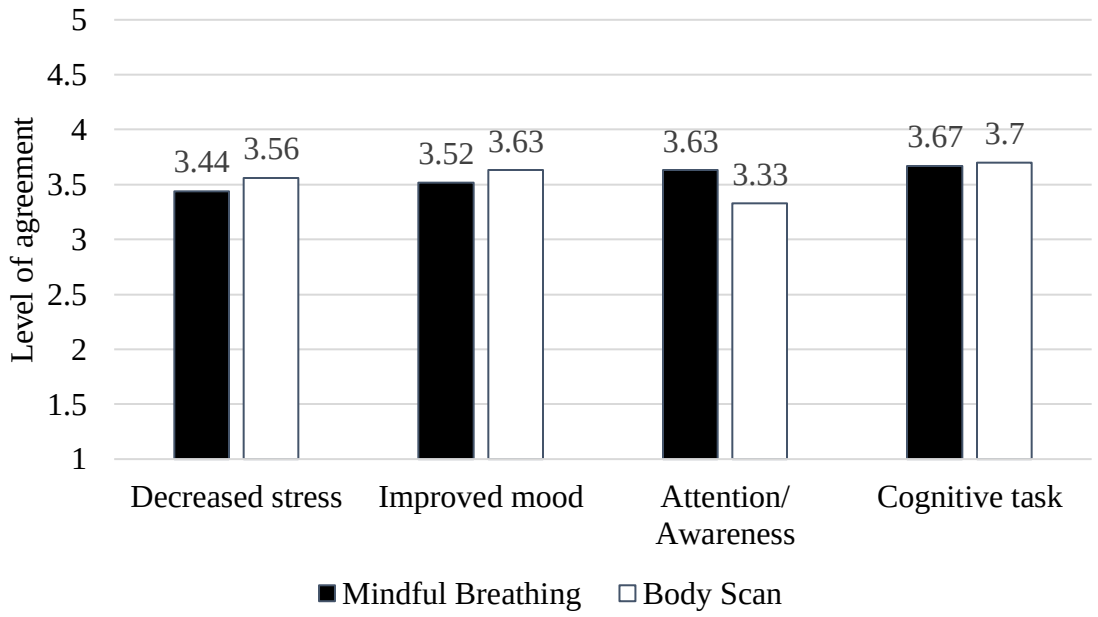

Figure 2. Perception of effectiveness by mindfulness condition

Appendix A

Mindfulness, Attention, Awareness Scale (MAAS)

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	**Very Frequently**	**Somewhat Frequently**	**Somewhat Infrequently**	**Very Infrequently**	**Almost Never**

I could be experiencing some emotion and not be conscious of it until some time later.	**1**	**2**	**3**	**4**	**5**	**6**
I break or spill things because of carelessness, not paying attention, or thinking of something else.	**1**	**2**	**3**	**4**	**5**	**6**
I find it difficult to stay focused on what's happening in the present.	**1**	**2**	**3**	**4**	**5**	**6**
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	**1**	**2**	**3**	**4**	**5**	**6**
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	**1**	**2**	**3**	**4**	**5**	**6**
I forget a person's name almost as soon as I've been told it for the first time.	**1**	**2**	**3**	**4**	**5**	**6**
It seems I am "running on automatic," without much awareness of what I'm doing.	**1**	**2**	**3**	**4**	**5**	**6**
I rush through activities without being really attentive to them.	**1**	**2**	**3**	**4**	**5**	**6**
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	**1**	**2**	**3**	**4**	**5**	**6**
I do jobs or tasks automatically, without being aware of what I'm doing.	**1**	**2**	**3**	**4**	**5**	**6**
I find myself listening to someone with one ear, doing something else at the same time.	**1**	**2**	**3**	**4**	**5**	**6**
I drive places on 'automatic pilot' and then wonder why I went there.	**1**	**2**	**3**	**4**	**5**	**6**
I find myself preoccupied with the future or the past.	**1**	**2**	**3**	**4**	**5**	**6**
I find myself doing things without paying attention.	**1**	**2**	**3**	**4**	**5**	**6**
I snack without being aware that I'm eating.	**1**	**2**	**3**	**4**	**5**	**6**

Appendix B

Depression, Anxiety, Stress Scale – 21 (DASS-21)

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:
0 Did not apply to me at all-NEVER
1 Applied to me to some degree, or some of the time - SOMETIMES
2 Applied to me to a considerable degree, or a good part of time - OFTEN
3 Applied to me very much, or most of the time - ALMOST ALWAYS

I found it hard to wind down.	**0**	**1**	**2**	**3**
I was aware of dryness of my mouth	**0**	**1**	**2**	**3**
I couldn't seem to experience any positive feelings at all	**0**	**1**	**2**	**3**
I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)	**0**	**1**	**2**	**3**
I found it difficult to work up the initiative to do things	**0**	**1**	**2**	**3**
I tended to over-react to situations	**0**	**1**	**2**	**3**
I experienced trembling (e.g., in the hands)	**0**	**1**	**2**	**3**
I felt that I was using a lot of nervous energy	**0**	**1**	**2**	**3**
I was worried about situations in which I might panic and make a fool of myself	**0**	**1**	**2**	**3**
I felt that I had nothing to look forward to	**0**	**1**	**2**	**3**
I found myself getting agitated	**0**	**1**	**2**	**3**
I found it difficult to relax	**0**	**1**	**2**	**3**
I felt down-hearted and blue	**0**	**1**	**2**	**3**
I was intolerant of anything that kept me from getting on with that I was doing	**0**	**1**	**2**	**3**
I felt I was close to panic	**0**	**1**	**2**	**3**

I was unable to become enthusiastic about anything	**0**	**1**	**2**	**3**
I felt I wasn't worth much as a person	**0**	**1**	**2**	**3**
I felt that I was rather touchy	**0**	**1**	**2**	**3**
I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)	**0**	**1**	**2**	**3**
I felt scared without any good reason	**0**	**1**	**2**	**3**
I felt that life was meaningless	**0**	**1**	**2**	**3**

Appendix C

Positive and Negative Affect Scale (PANAS)

Instructions: Rate each describing word on a scale of 1 (very slightly or not at all) to 5 (extremely) based on how you feel right now.

1 = very slightly or not at all - 5 = extremely

Right now I feel…

1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

Appendix D

Demographics

1. Age:
2. Gender: Male Female Other Prefer not to share
3. Ethnicity: Caucasian Hispanic/Latino Asian/Pacific Islander African-American/Black American Indian/Alaskan Native Other
4. Year in school: 1st (typical freshman); 2nd (typical sophomore); 3rd (typical junior); 4th (typical senior); 5th or more
5. Major:

Appendix E

Manipulation Check and Mindfulness Strategy Questions

1. Have you had previous exposure to mindfulness practices? Yes No
2. If yes, which strategies have you practiced?

   Mindful breathing Body Scan Yoga Mindful eating Loving kindness Mantra Other (please specify): _____
3. To what extent do you feel the instructions provided were clear enough for you to understand what you were being asked to do?

   1. Not at all clear 2. To some extent clear 3. Mostly clear

   4. Clear 5. Clear to a great extent
4. To what extent did you follow instructions?

   1. Not at all 2. To some extent 3. Mostly followed instructions

   4. Followed instructions 5. Followed instructions to a great extent
5. How busy are you this week compared to other weeks (e.g., social events, classes, exams, etc.)?

   1 (less busy) 2 3 (typical week) 4 5 (more busy)
6. I felt awkward while practicing the assigned strategy.

   Strongly Disagree Disagree Neutral Agree Strongly Agree N/A
7. This is a strategy I will practice in the future.

   Strongly Disagree Disagree Neutral Agree Strongly Agree N/A
8. On a scale of 1-10 (1 = not stressed; 10 = extremely stressed) how stressful has your week been compared to a "typical" week?

   1 2 3 4 5 6 7 8 9 10

9. I enjoyed practicing the mindfulness strategy.

   Strongly Disagree Disagree Neutral Agree Strongly Agree N/A

10. I am glad I practiced the mindfulness strategy.

    Strongly Disagree Disagree Neutral Agree Strongly Agree N/A

11. Practicing the mindfulness strategy decreased my stress level(s).

    Strongly Disagree Disagree Neutral Agree Strongly Agree N/A

12. Practicing the mindfulness strategy improved my mood.

    Strongly Disagree Disagree Neutral Agree Strongly Agree N/A

13. Practicing the mindfulness strategy improved my attention and awareness.

    Strongly Disagree Disagree Neutral Agree Strongly Agree N/A

14. Practicing the mindfulness strategy helped me to perform better on the cognitive task done in the lab.

    Strongly Disagree Disagree Neutral Agree Strongly Agree N/A

15. Has anything happened this week that would add stress atypical of the normal weekly college stresses (e.g., big life events, receiving important news, and/or traumatic experience)?

    (Write in): _____

16. Has anything extremely positive happened that would cause a higher level of happiness than a normal college week (e.g., got a good grade on an exam, received good news)?

    (Write in): _____

Appendix F

Recruitment Script

Hello,

My name is Kate Haschke and I am a graduate student in the Clinical Psychology program here at Fort Hays. I would like to invite you to participate in a psychology experiment. The purpose of our experiment is to see how different brief mindfulness-based strategies (a mindful breathing exercise or a body scan) effect attention and awareness, depression, anxiety, stress, mood and performance. If you choose to participate, it would require coming to the lab in Martin Allen twice—once at the beginning of the week and once at the end of the week—to practice a mindfulness strategy and respond to different questions. Your participation might require that you download a free application to your smart phone. If you do not have a smart phone, please bring a tablet or other electronic device to the lab session. These lab sessions will take approximately 20 to 30 minutes each time. You will also be asked to complete three individual practice sessions between the initial and final lab sessions which will take approximately 3 minutes. If your instructor is offering extra credit or research credit, it will be required of you to complete all sessions—the initial lab session, three individual practice sessions, and a final lab session—for the full credit. By participating, you may learn new strategies you may find helpful for managing stress. We would appreciate your help with this research project. If you would like to participate please follow the link provided:

[link will go here]

After clicking on the link, or after typing it into a web browser, you will be asked to type your name, and also to choose a time slot during which you can participate in the experiment. Once you have signed up, the researchers will contact you with more information about where to go.

Thank you!

Katelyn Haschke
kjhaschke@mail.fhsu.edu
Dr. Whitney Jeter
wkjeter@fhsu.edu
(Thesis Advisor)

Appendix G

Informed Consent Form

CONSENT TO PARTICIPATE IN RESEARCH

Department of Psychology, Fort Hays State University

Study title: Mobile mindfulness: There's an app for that!
Name of Researcher: Katelyn Haschke
Faculty Advisor: Dr. Whitney Jeter
Contact Information: kjhaschke@mail.fhsu.edu; wkjeter@fhsu.edu

You are being asked to participate in a research study. It is your choice whether or not to participate.
Your decision whether or not to participate will have no effect on your *academic standing in your course(s) or at Fort Hays State University* to which you are otherwise entitled, please ask questions if there is anything you do not understand.

What is the purpose of this study?
The purpose of the study is to see how different strategies effect individuals' mood, attention and awareness, depression, anxiety, stress, and performance on a given task. You might be assigned to learn and practice a mindfulness strategy (either mindful breathing or a body scan). To practice this technique, you will be asked to download a free application (*Smiling Mind*) on your smart phone or through an electronic device (e.g., iPad, laptop).

What does this study involve?
As part of this study, you will be asked to complete some short questionnaires about your current mood, attention and awareness, depression, anxiety, and stress. Next, you might learn a brief mindfulness strategy (for example: mindful breathing or a body scan) introduced through a phone application, "Smiling Mind." After engaging in the mindfulness strategy, you will complete a task on the computer that will require you to retain new information. For the next three days, you will be asked to practice the brief mindfulness strategy that you learned. On the final day, you will come back to the lab to practice the strategy and complete the same task learned in the initial session with the same questionnaires.

If you decide to participate in this research study, you will be asked to sign this consent form after you have had all your questions answered and understand what will happen to you. The length of time of your participation in this study is 20 minutes today, less than 5 minutes per day over the three days of practice, and 20 minutes at the end of the week. Approximately 100 participants will be in this study.

Are there any benefits from participating in this study?

Participants will benefit from the knowledge gained of the scientific process through participation and exposure to research. Participants may also find the strategy to be applicable after the study is completed and continue to engage in the strategy they are introduced to for continued benefits. Essentially, this research can also be a teaching moment, especially for general psychology students who may not be aware of the scientific nature of psychology. FHSU (and participants) may benefit from any tangible knowledge gained during this study. Also, students may benefit by receiving course credit or extra credit for participating. In these instances, professors will offer equitable alternative options in order to give students other opportunities to receive the same amount of credit, even if they do not want to participate in this project.

Will you be paid or receive anything to participate in this study?

You will not receive any compensation for participation in this experiment. However, you may receive extra credit or research credit, but this is at your instructor's discretion.

What about the costs of this study?

There are no costs to you for participation in this experiment. However, you might learn a strategy that you have not experienced or practiced before. Because of this new experience, you might feel a little awkward or uncomfortable. Please remember that your participation is voluntary and you may stop the study at any time.

What are the risks involved with being enrolled in this study?

It is unlikely that this project will result in harm to you as a participant. The amount of stress associated with this experiment is similar to the amount of stress associated with taking any online survey, or taking an ungraded math test. However, if you do experience abnormal stress you will be able to stop participation at any moment with no penalty. A researcher will be in the room at all times to help you if you feel uncomfortable or distressed.

How will your privacy be protected?

Efforts will be made to protect the identities of the participants and the confidentiality of the research data used in this study. Potentially identifiable information about you will consist of your answers to the surveys, given task, and your demographics (i.e., age, sex, ethnicity). Data is collected only for research purposes. Your data will be identified by ID number, not name, so there will be no way to tie your name back to your responses in the data. All personal identifying information, such as your signature on this Informed Consent, will be kept in locked files and these files will be shredded approximately 3 years after publication of this data. Data files which do not contain your identifying information will be kept in an electronic file for five years. However, access to all data will be limited to the principal researcher.

The information collected for this study will be used only for the purposes of conducting this study. What we find from this study may be presented at meetings or published in papers but your name will never be used in these presentations or papers.

Other important items you should know:

• **Withdrawal from the study:** You may choose to stop your participation in this study at any time. Your decision to stop your participation will have no effect on the *academic standing in your course(s) or at Fort Hays State University.*

• **Funding:** There is no outside funding for this research project.

Whom should you call with questions about this study ?

Questions about this study should be directed to Katelyn Haschke (kjhaschke@mail.fhsu.edu) or Dr. Whitney Jeter (wkjeter@fhsu.edu). You also may contact the Kelly Center (785-628-4401) and/or the Chair of the Ethics Committee for the Psychology department (Dr. Trey Hill; wthill@fhsu.edu). If you have questions, concerns, or suggestions about human research at FHSU, you may call the Office of Scholarship and Sponsored Projects at FHSU (785) 628-4349 during normal business hours.

CONSENT

I have read the above information about ***Mobile mindfulness: There's an app for that!*** and have been given an opportunity to ask questions. By signing this I agree to participate in this study and I have been given a copy of this signed consent document for my own records. I understand that I can change my mind and withdraw my consent at any time. By signing this consent form I understand that I am not giving up any legal rights. I am 18 years or older.

_____

Participant's Signature and Date

Appendix H

Debriefing Form

"Mobile Mindfulness: There's an App for That!"
Debriefing Form

You have just completed a study titled "Mobile Mindfulness: There's an App for That!" The purpose of this study was to examine how different brief mindfulness-based strategies affect an individual's attention and awareness, depression, anxiety, stress, mood and performance on cognitive tasks. You were asked to practice the strategy taught in the initial session and fill out different questionnaires as well as completing a cognitive task. The information provided will help researchers understand how impactful different strategies can be for the individual incorporating them in their daily life for brief practices. It is hoped that the research will help us understand ways that can help individuals perform more successfully and also feel better.

The research team greatly appreciates your help with this project! If you feel distressed after your participation in this project, you can contact the Kelly Center (free to students) at 785-628-4401 to schedule an appointment to talk with someone about how the project impacted you, or the Office of Scholarship and Sponsored Projects at 785-625-4349 if you have questions about the process of this research project. For more information about the research project, you can contact the principal researcher, Katelyn Haschke, at kjhaschke@mail.fhsu.edu.

Sincerely,
Katelyn Haschke
kjhaschke@mail.fhsu.edu

Dr. Whitney Jeter
wkjeter@fhsu.edu
(Thesis Advisor)

Appendix I

IRB Approval Letter

FORT HAYS STATE UNIVERSITY

Forward thinking. World ready.

OFFICE OF SCHOLARSHIP AND SPONSORED PROJECTS

DATE:	September 29, 2017
TO:	Katelyn Haschke
FROM:	Fort Hays State University IRB
STUDY TITLE:	[1130148-1] Mobile Mindfulness: There's an App for That!
IRB REFERENCE #:	18-021
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	September 28, 2017
EXPIRATION DATE:	September 28, 2018
REVIEW TYPE:	Full Committee Review

Thank you for your submission of New Project materials for this research study. Fort Hays State University IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Full Committee Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form unless documentation of consent has been waived by the IRB. Informed consent must continue

throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document. The IRB-approved consent document must be used.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.

Based on the risks, this project requires Continuing Review by this office on an annual basis. Please use the appropriate renewal forms for this procedure.

If you have any questions, please contact Leslie Paige at 785-628-4349 or lpaige@fhsu.edu. Please include your study title and reference number in all correspondence with this office.