CHAPTER I

INTRODUCTION

"Between stimulus and response there is a space. In that space is our power to choose our response. In our response lies our growth and our freedom." Viktor Frankl

Overview of Mindfulness

Mindfulness is translated from Pali, an Indic language, closely related to Sanskrit. In sacred texts mindfulness is described as "awareness, circumspection, discernment, and retention" (Shapiro, 2009, p. 556). Mindfulness is considered a process as well as an outcome. The construct mindfulness is frequently associated with Buddhism, yet the phenomenological nature of mindfulness embodies numerous religious and Eastern spiritual traditions. Mindfulness is also embedded in many Western philosophical and psychological ideologies (Shapiro, 2009). Although the concept of mindfulness is grounded in Buddhism, it is currently being practiced in a myriad of contemplative traditions where conscious attention and awareness are being cultivated (Brown & Ryan, 2003).

The ability to be mindful is inherent. All individuals have the capacity to attend to the present moment when motivated to do so. Therefore, everyone can benefit from the quality of consciousness that mindfulness elicits. This heightened sense of alertness enables people to appreciate moment to moment experiences and augments overall well-being (Brown & Ryan, 2003).

Mindfulness helps people cope with the evolutionary burden of conditioned negative thinking. There was a time when it was adaptable to analyze a situation and process all potential negative outcomes. When humans were cohabiting with dangerous animals, this type of thinking was necessary. Today humans are not faced with the same physical threats, but our evolutionary programming has not yet altered to meet the needs of today's society. Mindfulness teaches practitioners to let go of negative thoughts and subsequently reduces catastrophizing and other cognitive distortions. Mindfulness practice results in less

depression and greater inner peace (Williams, Teasdale, Segal, & Kabat-Zinn, 2007), which may be why it's becoming increasingly popular.

Mindfulness practices emphasizes monotasking and in a culture of multitasking, this can be a refreshing reprieve. With the advent of complicated technology, our brains are being overstimulated by constant notifications whether it be email alerts or social media notifications. Our brains begin to normalize the constant flood of information and as a result homeostasis is altered. People no longer feel comfortable simply "being" and as a result spend most of their time "doing," leaving them no time for a mental or physical break. This results in chronic stress and a low-grade fight or flight response, which is extremely taxing on the body (Peirce-Thompson, 2017). The mounting stress and fatigue has motivated people to find out what the practice of mindfulness has to offer.

Recently, the practice of mindfulness has found a place in mainstream culture. Everyone from U.S military to professional athletes to politicians is practicing mindfulness to enhance performance and overall productivity. In 2014, TIME Magazine ran a cover story titled, *The Mindful Revolution: The Science of Finding Focus in a Stressed-Out Multitasking Culture.* Shortly after, mindfulness gained additional momentum when American journalist, author, and TV personality Anderson Cooper dedicated a prime-time segment detailing his personal transformative experience after attending one of Jon Kabat-Zinn's mindfulness retreats (Ciccone, 2016).

In western culture, mindfulness is most often defined by Jon Kabat-Zinn. He describes mindfulness as the ability to pay attention in the current moment without judgment or being present with a sense of "heartfulness" (Kabat-Zinn, 2003). According to Kabat-Zinn (2003), mindfulness is comparative to insight-oriented meditation, where the individual is seeking a sense of personal enlightenment by practicing persistent inquiry. This transcendental seeking is considered science driven. It is a pragmatic way to inform cognitions and better understand the overall human experience.

Jon Kabat-Zinn got his educational start in science. He received his Ph.D. in molecular biology at the Massachusetts Institute of Technology (MIT), where he was first

introduced to meditation. He continued his spiritual inquiry by studying with a variety of Buddhist teachers and maintaining a rigorous practice of yoga and meditation. While working at the University of Massachusetts Medical School (UMass) Jon Kabat-Zinn took advantage of his Buddhist teachings and developed a secular program for individuals struggling with debilitating chronic conditions. His program was initially referred to as the Stress Reduction and Relaxation Program and the main theme was "as long as you are breathing, there is more right with you than wrong with you" (Stress Reduction Clinic Authorized Curriculum Guide, 2015, p. 5). Kabat-Zinn later deemphasized the relationship between mindfulness and Buddhism to make the program more relatable to the general public. He renamed the course the *Mindfulness-Based Stress Reduction Program* (MBSR).

Mindfulness-Based Stress Reduction (MBSR)

The *Mindfulness-Based Stress Reduction Program* (MBSR) was created over 37 years ago at the University of Massachusetts (UMass) medical school by Jon Kabat-Zinn. According to the MBSR authorized curriculum guide, (2015) it was meticulously created in UMass's Stress Reduction Clinic over the course of three decades. The program aims to teach adult participants how to integrate and apply mindfulness on a daily basis. Participants seek treatment for a variety of different reasons; their challenges arise from medical and psychological conditions as well as the stressors of everyday life.

MBSR was the first well-established and thoroughly researched program of its kind and is now used in academic, medical, psychiatric, and community centers worldwide. The 8- week program spans nine sessions and includes an intense 7.5 hour long silent retreat between the sixth and seventh sessions. A variety of themes are covered over the course of 8 weeks and include: workable difficulties, trusting oneself, perception and creative responding, dynamics of stress reactivity and automaticity, pleasure in the present, flexible attentional capacity, learning to honor the full range of emotions, interpersonal balance and effective communication, being open to any experience, and adaptive life style choices (Stress Reduction Clinic Authorized Curriculum Guide, 2015). Many individuals have found therapeutic relief by engaging diligently in the meditative process associated with MBSR

(Kabat-Zinn, 2003).

Main Components of MBSR. The American Psychiatric Association has encouraged meditation as a potential therapeutic technique from as early as 1977 (La Torre, 2001). Realizing the therapeutic potential, Jon Kabat-Zinn created MBSR approximately 2 years later. MBSR is based on systematic and intensive training in both mindfulness meditation and mindful movement.

Sitting Meditation. According to Jon Kabat-Zinn (2013), sitting meditation is the heart of formal meditation practice. He believes that sitting meditation is the quintessential element for personal transformation and growth. Researchers have found many benefits to sitting meditation, especially when practicing loving kindness (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). Other forms of sitting meditation include: conscious awareness of breathe, the mountain meditation, and the lake meditation (Stress Reduction Clinic Authorized Curriculum Guide, 2015). The largest meta-analytical effect sizes are seen when focusing on anxiety and mood disorders. Medium to small effect sizes have been documented in treatment of physical ailments, such as chronic pain, sleep disorders, HIV, and heart disease (Shonin, Van Gordon, & Griffiths, 2014).

The practice of sitting meditation involves the maintenance of sustained attention while simultaneously redirecting attention back to the current moment and is therefore strongly related to the function of working memory (Quach, Jastrowski Mano, & Alexander, 2014). Research indicates that individuals with ample training in meditation show significant enhancement in overall cognitive performance. Expansion of visospatial and attentional processes and heightened activation in the areas of the brain responsible for working memory has been documented in a variety of studies (Zeidan, Johnson, Diamond, David, & Goolkasian, 2009). According to Zeidan et al. (2009), an intensive 3-month experiment, which required participants to meditate for approximately 10 hours a day, revealed improvement in sustained attention as demonstrated by quicker reaction times and a reduction in attentional blinks. Another study utilizing neuroimaging found that experienced meditators showed increased activity in attentional networks responsible for attending and

error monitoring (Zeidan et al., 2009). These results confirm that mindfulness meditation promotes growth in higher-order cognitive systems, like conflict monitoring and working memory.

Mindful Movement. Yoga is considered the earliest type of formal mindful movement. Yoga has been recognized throughout the Eastern and Western world alike as being extremely therapeutic and ameliorating a variety of different ailments. Research has concluded that yoga decreases anxiety and depression symptomology (Dale et al., 2009). Both clinical and subclinical populations have seen significant improvements in quality of life after practicing yoga. According to Dale et al. (2009), yoga has been proven to regulate self-control, improve self-efficacy and promote relaxation (Nemati, 2013). In addition to standing and lying down yoga, MBSR also teaches walking meditation and the body scan. The body scan meditation aims to bring awareness to the different regions of the body through mental scanning. The practice invites practitioners to allow all bodily sensations, without trying to change anything (Stress Reduction Clinic Authorized Curriculum Guide, 2015).

Similarly, to sitting meditation, mindful movement has a positive effect on working memory. Working memory is thought to play a role in the areas of the brain that control movement and discrete timing (Russel & Arcuri, 2015). Slow and deliberate movement, as seen in mindfulness, necessitates greater working memory capacity and as a result can stymie mind wandering. When attention is purposefully brought to movement it can train the brain to enhance working memory. These findings are especially important for people who are unable to remain stationary for an extended period. An individual suffering from schizophrenia or Parkinson's disease, for example, may not be physically able to engage in sitting meditation. Mindful movement is an empirically validated alternative (Russel & Arcuri, 2015).

Other Mindfulness Interventions

Many other specialized mindfulness interventions have developed from the roots of MBSR. These programs share the same seven-attitudinal factors of mindfulness. The first is

non-judging. The human brain automatically categorizes thoughts to save valuable time and energy. This process encourages people to make many snapshot conclusions known as judgments, which is typically an unconscious progression. To reach a place of non-judging, an individual must adapt an impartial stance while consciously observing his or her own inner experiences (Kabat-Zinn, 1990).

The second construct is *patience*. Patience is the ability to comprehend that some things must unfold in their own time without being hurried along. Patience is especially useful when the mind is perturbed. If an individual can accept both the tumultuous and serene mindstates, he or she is better able to appreciate the utter fullness of life (Kabat-Zinn, 1990).

The third construct is *beginner's mind*. People often get stuck in the same mindset. The more they complete an activity or think a particular thought, the stronger the neuronal activity is in that specific area of the brain. It takes concerted effort to try a novel strategy or "think outside of the box." Instead of spoiling the newness of each moment with previous experiences, individuals must, instead, be willing to see everything as if for the first time (Kabat-Zinn, 1990).

The fourth construct is *trust*. Believing that people have the innate capacity for inner wisdom is vital when establishing inner trust. It is imperative to honor this notion instead of looking for guidance in authority figures; only then can people truly grow more fully into themselves (Kabat-Zinn, 1990).

The fifth construct is *non-striving*. Most people need motivation to initially embark on a mindfulness journey, but that motivation serves merely as a spark and not a direct pathway, which must be precisely followed. Non-striving does not equate to laziness. "Being" in the present moment takes a concerted amount of effort. Over time, practicing mindfulness will lead toward a progression of goals, but only when allowed to unfold naturally (Kabat-Zinn, 1990).

The sixth construct is *acceptance*. Acceptance is seeing things for what they truly are in the present moment. Often acceptance is achieved only after much emotion upheaval and

a period of denial and anger. These emotional states are part of the life process and eventually people must come to terms with the reality of their occurrences. By deliberately cultivating acceptance, inner healing can begin (Kabat-Zinn, 1990).

The seventh and final construct is *letting go*. Developing the attitude of non-attachment is paramount to the practice of mindfulness. Individuals must first practice what it feels like to "hold on" and then cultivate the ability to let go. It is all too common to cling steadfastly to the things that are pleasurable and push away the things that are deemed unpleasant. This is counterintuitive. It creates fear and allows people to attach great meaning to inconsequential items (Kabat-Zinn, 1990). These seven attitudinal factors are consistent across all mindfulness programs, whether the intervention is intended for young people or adults.

Adult Interventions. *Mindfulness-Based Cognitive Therapy* (MBCT) combines mindfulness and cognitive therapy with a focus on chronically depressed individuals. MBCT is typically administered in a group setting and aims to reduce negative thinking patterns and the risk of potential relapse. In order to reduce the ruminative nature of depression, individuals are taught to utilize "non judging" and "non attachment." The ability to detach from recurrent thoughts and avoid self-deprecation allows people to relate to cognitions as transient mental events. This way people refrain from mistakenly labeling thoughts as facts and subsequently viewing the self as flawed (Teasdale et al., 2000).

Mindfulness-Based Childbirth and Parenting (MBCP) aids expecting parents through the guidance of mindfulness. Pregnancy is often a confusing and scary time, especially for mothers. MBCP attempts to normalize the challenges that arise during pregnancy and decrease the fears that accompany childbirth. Mindfulness techniques are taught throughout a 10-session program. Emphasis is placed on improving self-regulation skills to promote both physical and emotional well-being (Duncan & Bardacke, 2010).

Interventions for Adolescents and Children. Initially, mindfulness interventions were developed solely for adults, but in recent years programs have been designed specifically to help children and adolescents. Mindfulness is advantageous for young people

because they have the natural ability to cultivate a "beginner's mind." Children and adolescents are not biased by past experiences nor do they assume the role of "expert" in any given field, and as a result are free to view each experience with fresh eyes (Goodman, 2005; Kabat-Zinn, 1990).

Mindfulness-Based Stress Reduction for Children (MBSR-C) and *Mindfulness-Based Stress Reduction for Teens* (MBSR-T) are independently developed programs that employ developmental theory while taking cognitive and cultural factors into consideration. Manualized practices are provided for children and adolescents, respectively. Daily mindfulness is encouraged and young people are instructed to hold space between a triggering event and an emotional response to lead a more emotionally balanced life (Biegel, Chang, Garrett, & Edwards, 2014; Saltzman & Goldin, In Press).

The Child Mind Institute is an independent nonprofit organization located in New York City. This in-house and online resource provides families with the most up to date research on mindfulness and provides an extensive list of referral sources. The goal of The Child Mind Institute is to present the most advanced science available on the developing brain while supporting and fostering a sense of empowerment to parents and other child advocates (http://childmind.org/article/the-power-of-mindfulness/).

The Mindsight Institute is across the country in Santa Monica, California. The acclaimed executive director, Daniel J. Siegel, M.D. who is also the co-director of the Mindful Awareness Research Center, is a strong advocate for mindfulness. It is the mission of Dr. Siegel and his team to promote interpersonal neurobiology (IPNB), which is an interdisciplinary field looking to better understand the relation between the mind and mental health and how the brain is shaped by interpersonal relationships. The institute offers parents, educators and mental health professionals the opportunity to take classes to better understand how to help children. (https://www.mindsightinstitute.com/about-us).

School Interventions. In more recent years, mindfulness programs have begun implementation in the school setting. The *SMART-in-Education* program teaches self-care to academic personnel through mindfulness. SMART, which stands for Stress Management and

Relaxation Techniques, fosters a sense of school connectedness for students, faculty and the larger global community (Cullen, 2011).

Current research indicates that mindful students have higher levels of emotional intelligence, which correlates positively with academic achievement (Abdo, 2012). *Mindful Schools, Learning to BREATHE* (L2B), and *MindUP* are some of the more prominent, research-based, intervention programs for school-aged children and adolescents. *MindUP* was created by The Hawn Foundation and "teaches social and emotional learning skills that link cognitive neuroscience, positive psychology and mindful awareness training utilizing a brain centric approach." (http://thehawnfoundation.org/mindup/). *Mindful Schools and Learning to BREATHE* (L2B) are two programs that have been able to cultivate a sense of overall well-being and heighten school-connectedness through empowering students and staff by utilizing the techniques of mindfulness. (Metz et al., 2013) & (Zenner, Herrnleben-Kurz, & Walach, 2014).

Attention is the core component of *L2B*. Students and teachers are asked to practice present-moment awareness by slowing down long enough to pay attention to momentary experiences (Broderick, 2013). The curriculum aims to improve student mental health by enhancing the capacity for self-management and integrating mindfulness into everyday life. *Mindful Schools* helps students dealing with toxic stress by teaching them the importance of concentration, clarity, and equanimity. Throughout an 8-week curriculum, students learn to increase attention and compassion, practice emotion regulation, and curb impulsivity while remaining engaged in the school climate (mindfulschools.org).

For these programs to find their niche, they must stray somewhat from the roots of MBSR, which, as stated above, is the most sought after and successfully researched program available. Kabat-Zinn (1990) emphasizes that the core of MBSR is the formal practice, and these shortened versions do not allow for the same kind of stability, which he so strongly stresses. Although the *MindUP* curriculum correlates well with the Common Core standards

and is accredited by Collaborative for Academic, Social, and Emotional Learning (CASEL), it is a short-term program that includes only 15 lessons. *Learning to BREATHE* (L2B) was also recognized in the 2015 CASEL Guide as meeting research criteria for effective SEL programs, but it is also an abbreviated version made up of six themes which are typically delivered in 6, 12, or 18 sessions built around the acronym BREATHE. Lastly, *Mindful Schools*, which is arguably the most popular program, provides educators the chance to take one of three courses: Mindfulness Fundamentals, Mindful Educator Essentials, and the Year-Long Certification. While *Mindful Schools* affords many opportunities for teachers to partake in training sessions, it is still presented as a truncated program. Although these interventions differ in specific methodology, they are each based on neuroscience and emphasize the importance of self-regulation, stress reduction, and the positive effects on child and adolescent brain development.

Adolescent Brain

Adolescence is the ambiguous time between childhood and adulthood where individuals are beginning to separate from parental identity and gravitate more toward peer socialization. In the past, adolescence was considered a teenage phenomenon. But adolescence now spans from age 12 to well into the mid-20s, especially with the current economic standings resulting in more financial dependence on caregivers (Luciana, 2013).

Adults often judge adolescents harshly and equate poor decision-making strategies with a lack of compassion or a sense of entitlement. Although this may be true for some individuals, most adolescents are struggling to juggle the physical and social changes that are taking place in their lives. During this time, it is typical for adolescents to spend more time with their peers than with their parents. This newfound audience elevates risk-taking behavior (Luciana, 2013). The brain of an adolescent is beginning to modify a dopamine reward system, which means there is more activation in the neural networks responsible for dopamine. This heightened activity correlates with adolescent's reward drive and their thrill

seeking behavior (Siegel, 2013). In addition, hyperrational thinking is occurring simultaneously (Luciana, 2013). Concurrently, the cognitive and affective neural networks that are beginning to align in adolescents compete with one another when over stimulated. It is only when individuals get older that they can manage information-processing demands that activate multiple brain systems (Luciana, 2013). Adolescents are not simply hormone obsessed, impulsive and immature young individuals; they are individuals doing the best that they can while going through intensive brain restructuring.

In terms of adolescent brain structure, the outer bark of the brain is called the cortex. The cortex is often referred to as the "master control center" because it oversees maintaining overall homeostasis and coordinates the balance of the brain and the body (Siegel, 2013). The cortex is primarily responsible for conscious awareness and enables humans to plan, remember, and reflect, among other things. The limbic area of the brain is below the cortex and is responsible for attention, focus, and motivation. The amygdala and hippocampus are part of this region and help with memory processes and emotion regulation. The cerebellum is located behind the limbic area. It aims to keep balance between thoughts and feelings as well as oversee psychomotor functioning. The brainstem is located below the limbic system and is responsible for more automatic functioning like the sleep and wake cycles. It also activates emotional reactivity, such as fear or rage (Siegel, 2013).

The brain is a network of cells that communicates systematically through the delivery of chemicals, which are termed neurotransmitters (Siegel, 2013). Neurological integration is when the brain links together and successfully grow cognitive fibers that inhibit excessive impulsivity (Siegel, 2013). Myelin is the term used to describe a sheath that covers nerve membranes. Thanks to this protective casing, neurons move with more speed and allow synchronicity and subsequent brain integration (Siegel, 2013). The combination of pruning and the dramatic increase of myelin production, along with alternations in hormonal states and gene expressions result in heightened neural activity and synaptic growth in the adolescent brain (Siegel, 2013). Additionally, the prefrontal lobes, located in the forefront of the frontal lobe of the cortex, grow significantly. This growth allows for the start of

divergent thinking and metacognitive processes. Metacognition, which is knowing about knowing, is unique to the human species and helps to reduce impulsivity and risk taking behaviors (Siegel, 2013).

During this period, the brain is a true work in progress and is sensitive to slight internal or external provocations. Over time and through metacognition the prefrontal cortex can initiate calming circuits, known as inhibitory fibers, which neutralize an overactive limbic system. Research consistently finds that adults are more capable than adolescents to decrease amygdala activation by allowing their higher cortex to get involved and filter potentially threatening stimuli more effectively (Siegel, 2013).

Stress and the brain. As mentioned above, the process of synaptic elimination known as pruning is in full effect during adolescence. If an adolescent is experiencing high stress, pruning is often more intense, and previously hidden vulnerabilities may surface. This process will interfere with neural integration (Siegel, 2013). For adolescents to successfully regulate emotions they must develop neural integration, which results from self-inquiry. This linkage creates the space to develop a sense of self-understanding and empathy towards others. Not only does this integrated network foster an overall sense of well-being, but it also promotes healthy relationships, all of which lead to stress reduction (Siegel, 2013).

Although adolescence can be a tumultuous time with dramatic neurological, hormonal and social changes, most youngsters are able to enjoy the emotional spark and novelty (Siegel, 2013) that accompanies this time in development. Unfortunately, this is not the case for all adolescents. Mental illness begins to emerge during this time. According to the 2015 revision of the Center for Disease Control and Prevention (CDC), mental health problems in adolescence can become chronic, life long health conditions. Adolescents struggling with mental illness have a much harder time with self-regulation. These failures may occur due to excessive demands being placed on the brain without sufficient neural integration or the facility to manage them. Additionally, arousal systems may not be functioning ideally, negatively effecting circadian rhythms and sleep quality. Bodily changes that coincide with puberty can also add to the general disequilibrium (Luciana, 2013).

Not all stressors are intrinsic or internally based. Many external pressures exist as well. Adolescents are no longer dependent on their caregivers, resulting in more emphasis on peer involvement. Social hierarchies are being explored and new relationships are being established (Luciana, 2013). Many adolescents feel the pressure to conform to different roles in social and educational domains. For some adolescents, achieving academic accolades becomes a large part of their personal identity. These students are particularly influenced by the increasing scholastic demands in the form of high stakes testing.

Stress in high stakes testing. The Common Core is a set of American scholastic standards in mathematics and English that is currently being implemented by 42 states and some argue is more intense than previous exit exams. Requirements vary state by state (www.corestandards.org/). There has been a recent surge of research and special attention paid to the effects of high stakes testing on learning outcomes, as well as consequences for teachers; however, there is minimal empirical data on student perspective. Two previous studies utilized student drawings to interpret their perceptions of high stake testing. The artwork revealed a sense of anxiety and decrease in school connectedness, especially with older students (Smyth & Banks, 2012).

According to Ysseldyke et al., (2004), in Louisiana, a state test cannot be overruled and as a result, 15% of 4th and 8th grade students have recently been retained. Consequently, students actively report being overwhelmed by stress. In 2000, the National Center for Fair and Open Testing and the Coalition for Authentic Reform interviewed students and education officials to obtain anecdotal information regarding high-stakes testing. In one interview, a local education official in Massachusetts illuminated the potentially devastating results of high stakes testing. This individual observed an increase in dropout rates and a decrease in academic confidence, especially for those individuals diagnosed with a disability. One special education student from Massachusetts indicated that after failing his exit exam, he felt that school was worthless and he was no longer a viable candidate for college or a post high school career (Ysseldyke et al., 2004). Another 4th grader reported feeling a sense of nervousness for the entire duration of the school year due to test preparation. This

deflation of academic confidence and heightened sense of stress is not uncommon. One school in Massachusetts hired a relaxation therapist with the goal to alleviate student test anxiety (Ysseldyke et al., 2004).

The negative effects of high stakes testing are a global concern. In one study in Ireland, interviews were conducted with 100 focus groups of either 3rd or 6th year students. This qualitative information was corroborated with quantitative data. Approximately 93-94% of students indicated that it was very important for them to do well on their high stakes exam. One student expressed grave concern stating that her entire life and future depended on this test. Another student described the pressure as omnipresent and admitted to being preoccupied with the test during the weekends (Smyth & Banks, 2012).

Policy makers are attempting to improve common core standards by keeping up to date with research and making appropriate changes when necessary. At least for the time being these tests are here to stay, which means that students will continue to be affected by the pressure caused by these tests. Schools must make room in their curriculum to provide ways for students to deal with this stress.

Mindfulness and the brain. When practiced regularly, mindfulness has the potential to be life changing. A mounting body of evidence, indicates that meditation can slow aging at the cellular level. Research has shown that long-term meditators have elongated telomeres, which are the DNA and protein caps that protect the base of each chromosome during cell division. These caps get slightly smaller each time the chromosome replicates, until inevitable cellular death (Kingsland, 2016). When same-age individuals with comparable lifestyles are assessed based on whether they are engaging in meditation, those individuals practicing meditation have longer telomeres. Chronic stress has been found to negatively affect immune functioning, increase cellular inflammation and shorten the length of telomeres (Kingsland, 2016). Mindfulness practice can decrease chronic stress and alter brain chemistry. Research indicates that these beneficial effects are achieved by changes in underlying brain processes (Kilpatrick et al., 2011).

Mindfulness is frequently portrayed as a type of brain training. It is often

operationalized as a "set of attention-based, regulatory, and self-inquiry training regimes" (Lutz, Jha, Dunne, & Saron, 2015, p.632). Through interoceptive sensations, cognitions and feeling states, mindfulness trains individuals to remain focused on present moment experience. When the individual notices that attention has been lost, mindfulness promotes nonjudgmental refocusing and shifting attention back to one of the multiple sensory domains, which actively helps to reduce mind wandering. It is theorized that practicing mindfulness will result in the transformation of brain networks that are responsible for attention (Kilpatrick et al., 2011).

In a study conducted by Kilpatrick et al. (2011), a functional connectivity MRI (fcMRI) was used to measure brain activity. After an 8-week MBSR course, subjects showed significant alterations in brain functioning. There was an obvious change in functional connectivity within both visual and auditory neural networks. In addition, the visual and auditory cortexes showed an increase in ability for self-reflection and attentional processes.

Jao et al. (2016) tested 18 Taoist meditators with variable experience using a within-subjects design. Concurrent with findings from the Kilpatrick et al. (2011) study, this study demonstrated changes in topological and spatial networks. Findings indicated that the changes were associated with transient alterations in consciousness and may be linked to a more global level of brain integration.

Another experiment conducted by Froeliger et al. (2012) utilized a fMRI to compare seasoned meditators to meditation naive participants. The study suggested that practicing mindfulness meditation over time results in improved functional connectivity within the Dorsal Attention Network while concomitantly solidifying the pairing between distributed networks and affective response, regardless of being in a resting or active state. This study is significant because the findings are the first to recognize the effects of meditation on a variety of resting state networks (Froeliger et al., 2012).

Research looking specifically at improving working memory through mindfulness techniques, although in its nascent stage, is more established with the adult population than with children and adolescents. There is a growing amount of literature that supports the

enhancement of attention and working memory for adults through mindfulness training (Lutz et al., 2015). One experiment compared a passive control to a group participating in a MBSR-style mindfulness training. Using the attention network test (ANT), which is a task developed to assess three attentional networks: alerting, orienting, and executive functioning (Fan, McCandliss, Sommer, Raz, & Posner, 2002), researchers found that participants in the MBSR group were more efficient at orienting and better able to consciously direct attention (Lutz et al., 2015). Another study employing the Stroop task, which measures reaction time while participants name the color of ink for various congruent and incongruent words, asked individuals with no prior mindfulness training to participate in a 16-week mindfulness program. Results indicated changes in the left occipito-temporal region of the brain, which suggests better selection for target colors when completing the Stroop task. Improvement was also noted in perceptual feature processing, which correlates with what is currently known about the effects of attentional selection for color (Lutz et al., 2015).

Further experiments demonstrate improvement in preferential processing of attended stimuli while engaging in tasks that necessitate quick conscious retrieval of information (Lutz et al., 2015) and three recent studies (Morrison, Goolsarran, Rogers, & Jha, 2014; Mrazek, Franlin, Phillips, Baird, & Schooler, 2013; Zanesco, King, Maclean, & Saron, 2013) have found that mindfulness training decreases the tendency to mind-wander as measured by self-reports and task performance indices. This supports the idea that mindfulness training improves working memory capacity, subsequently altering neural networking (Lutz et al., 2015).

Working Memory

Working memory is part of a larger construct known as executive functioning, which is a comprehensive and multifarious construct made up of a variety of higher-order neural networks (Suchy, 2009). These networks are often separated into three interrelated, but distinct components: inhibition, working memory, and shifting (Best & Miller, 2010). Executive functioning allows humans to engage in novel problem solving approaches and enables individuals to alter a course of action, as needed, based on the surrounding

environmental stimuli. In addition, executive functioning facilitates intricate planning strategies and regulates emotional responses to maintain goal-oriented behavior (Williams, Suchy, & Rau, 2009). These processes are unique to the human species and allow us the autonomy to contemplate multiple responses in reaction to a particular stimulus. This evolutionary advantage requires a great deal of energy while being utilized and therefore stays inactive unless consciously initiated (Suchy, 2009).

In terms of neuroanatomy, executive functioning has typically been associated with the prefrontal cortex. The prefrontal cortex, located in the forefront of the frontal lobe, just behind the forehead, is divided into three sections: the dorsolateral, superior medial, and the ventral, which is subsequently split into the orbitofrontal and ventromedial (Suchy, 2009). Previous research indicated that executive functioning was facilitated by the entirety of the prefrontal cortex and nothing else. In recent years, researchers have proven that executive functioning activates more areas of the brain than previously assumed. Executive functioning processes require the use of the parietal lobe, the basal ganglia, the thalamus, the cerebellum and additional cortical areas outside of the frontal lobes. Needless to say, executive functioning is an elaborate network, not localized in any straightforward manner (Suchy, 2009).

As mentioned above, executive functioning is typically separated into three components. This was solidified in a study by Miyake et al. (2000) who utilized a confirmatory factor analysis (CFA) to identify the three latent variables of inhibition, shifting, and working memory as distinct yet interrelated (Best & Miller, 2010). These foundational executive functions are most often cited as the totality of executive functioning.

Working memory is arguably the most complicated component of executive functioning (Best & Miller, 2010). The term “working memory” describes a system that permits temporary storage of newly acquired information while the brain is simultaneously performing some additional task or manipulation (Baddeley, 1992). All activity is completed while simultaneously refraining from utilizing any outside aids or prompts. Baddley (1992) explains that working memory skills must trigger either the visuospatial or verbal storage

system in conjunction with a coordinating central executive.

Compared to other components of executive functioning, working memory is considered more difficult to measure. Researchers assert that each task under investigation differs based on which structures in the brain are being activated. The need for "executive control" depends greatly on how much of the prefrontal cortex is being stimulated. When an individual is asked to repeat digits backwards he is initiating more executive involvement compared to when he is asked to merely repeat the digits without further manipulation (Best & Miller, 2010). Concurrently, many working memory tasks also require some amount of inhibition regulation, which is especially apparent in young children. Research indicates that, unlike other components of executive functioning, working memory does not show marked improvement over time nor is it heavily influenced by prior experiences. Instead, the trajectory appears to change proportionally with age as children move through developmental periods. By the time a child is 15 years old, working memory skills tend to level off (Best & Miller, 2010).

Working Memory and Academic Achievement. Research has been able to demonstrate an impressive correlation between scholastic success and Intelligence Quota (IQ) scores. When assessing a student's IQ, however, the score only dictates previously learned knowledge. In contrast, working memory is considered a measure of a child's learning potential. Working memory is not inhibited by previous experiences or preordained social circumstance; instead, it predicts a student's ability to learn (Alloway, 2009).

According to Alloway (2009), research indicates that working memory competence is highly correlated with the ability to learn and subsequent academic progress. Working memory can predict both current and future scholastic achievement in math and reading. This information leads researches to postulate that working memory deficits may result in pervasive learning difficulties in all academic domains. In addition, students dealing with severe learning deficits have more pronounced working memory issues compared with students struggling with issues milder in nature. Even after IQ is statistically controlled for in students with learning disabilities, there is a direct correlation between working memory and

scholastic achievement, which points to students with learning disabilities as having a fundamental deficit in working memory ability (Alloway, 2009).

It is difficult for students with working memory deficits to store the knowledge needed for task completion. Without being able to maintain sufficient information in their short-term memory, students are unable to remember details, follow step-by-step instructions or successfully complete multi-step assignments. This can result in information overload and feelings of being overwhelmed. Due to the persistent nature of working memory impairments, students are often unable to master typical learning sequences, which will consequently result in stunted general academic progress (Alloway, 2009).

Working Memory Interventions Involving Mindfulness. Currently, the most popular interventions aimed at improving working memory skills are memory training programs (Melby-Lervag & Hulme, 2013). Even though initial results for these memory training programs appeared promising (Witt, 2011), further research indicates that these conclusions are fallible. Meta-analyses reveal that although these interventions show reliable short-term improvements, there is no credibility in the maintenance of these skills nor is generalization achieved (Melby-Lervag, & Hulme, 2013).

There is only one known documented study that used a modified MBSR curriculum to assess improvement in adolescent's working memory skills. The study sought to investigate the influence of the main MBSR components on working memory, stress, anxiety, and mindfulness. Quach et al., (2014) developed an eight-session intervention that spanned four weeks. Students were randomly assigned to one of three groups: sitting meditation, hatha yoga, or a waitlist. A computerized working memory task and a variety of self-report measures were utilized at pre-test, post-test, and a 1-month follow-up. Unlike students in the hatha yoga and waitlist control groups, the students participating in the sitting meditation condition demonstrated significant improvements in working memory. No significant between- group differences were observed for stress, anxiety or mindfulness. Due to these results, the researchers concluded that the psychological benefits of mindfulness training may not be achieved in a truncated mindfulness intervention (Quach, et al., 2014).

The results of this study are promising, but the lack of significant findings for stress and mindfulness are disheartening, considering that these are two of the main skills learned in the MBSR program. Future research would benefit from a longer mindfulness intervention program aimed at improving adolescent's working memory skills, while reducing stress and increasing mindfulness. This is the purpose of the current study.

The Present Study

There is a lack of long-term improvement for students struggling with working memory deficits. Working memory skills are purported to be the best indicator of academic attainment, and these skills are minimally affected by environmental influence (Alloway, 2009), which means that they can affect students from all walks of life. Difficulty with working memory is arguably the greatest risk factor for educational underachievement.

As mentioned earlier, there is only one known study that attempts to improve adolescent's working memory skills through a modified MBSR curriculum. Although the last decade has brought rapid growth to the field of mindfulness, research on adolescents is still in its fledgling stages. The short-term intervention implemented by Quach et al. (2014), demonstrated that acquiring mindfulness skills has significant improvement on working memory functioning. As discussed above, the adolescent brain is reformatting, and this plasticity helps make it more receptive to intervention. A longer intervention will allow for even more enhancement, which is vital because the brain changes in adolescence can have direct influence on adult development at social, behavioral, and neurological levels (Luciana, 2013).

In addition, the school is an ideal environment to implement an intervention because it ensures continual mindfulness practice, and research supports the need for consistent practice (Kabat-Zinn, 2003). It also diminishes the need for nightly homework practice, which is often not completed (Quach et al., 2014). In addition, the students will be working with teachers who are well known and respected within the school community. The current study is novel in that it will implement the first known year-long intervention that utilizes a modified MBSR curriculum for adolescents. This curriculum is expected to significantly

increase working memory functioning while fostering a sense of mindfulness and decreasing stress.

Conceptual Hypotheses

The primary purpose of this study is to explore the effectiveness of a year-long mindfulness training on adolescents' working memory ability, as well as their levels of stress and mindfulness. Based on previous research the following was hypothesized:

Hypothesis one. Students who participate in the mindfulness group will show a significant increase in mindfulness skills, as measured by The Mindful Attention Awareness Scale-Adolescent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011), relative to the physical education group, controlling for pre-test at:

a. post-test

b. 1-month follow up.

Hypothesis two. Students who participate in the mindfulness group will show a decrease in autonomic stress response, as measured by a pulse oximeter, relative to the physical education group, controlling for pre-test at:

a. post-test

b. 1-month follow up.

Hypothesis three. Students who participate in the mindfulness group will improve their working memory skills, as measured by The Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005), relative to the physical education group, controlling for pre-test at:

a. post-test

b. 1-month follow up.

Hypothesis four. Students who participate in the mindfulness group, compared to the physical education group, will show an increase in mindfulness skills at post-test, controlling for pre-test, as measured by The Mindful Attention Awareness Scale-Adolsecent (*MAAS-A*;

Brown, West, Loverich, & Biegel, 2011) and this finding will be moderated by motivation, such that high levels of motivation will facilitate increased mindfulness skills.

Hypothesis five. Students who participate in the mindfulness group, compared to the physical education group, will show an increase in mindfulness skills at post-test, controlling for pre-test, as measured by The Mindful Attention Awareness Scale-Adolsecent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011) and this finding will be moderated by previous experience with meditation, such that more experience will facilitate increased mindfulness skills.

Hypothesis six. Students who participate in the mindfulness group, compared to the physical education group, will show an increase in mindfulness skills at post-test, controlling for pre-test, as measured by The Mindful Attention Awareness Scale-Adolescent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011) and this finding will be moderated by academic achievement, such that a higher GPA will facilitate increased mindfulness skills.

Hypothesis seven. Students who participate in the mindfulness group, compared to the physical education group, will show an increase in mindfulness skills at post-test, controlling for pre-test, as measured by The Mindful Attention Awareness Scale-Adolsecent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011) and this finding will be moderated by stress, such that less stress will facilitate increased mindfulness skills.

Hypothesis eight. Students who participate in the mindfulness group, compared to the physical education group, will show an increase in working memory skills at post-test, controlling for pre-test, as measured by The Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005), and this finding will be moderated by mindfulness, such that increased mindfulness skills will facilitate greater working memory skills.

Hypothesis nine. Students who participate in the mindfulness group, compared to the physical education group, will show an increase in working memory skills at post-test, controlling for pre-test, as measured by The Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005), and this finding will be moderated by stress, such that less stress will facilitate greater working memory skills.

CHAPTER II

METHOD

Participants

Participants for this study were 95 high school students between the ages of 14 and 17, in 10th through 12th grade. Exclusion criteria consisted of non-English speaking students and students with visual impairments because these factors would have hindered completion of the questionnaires and the working memory task. With an alpha level of .05 (Cohen, 1992), and assuming a large effect size, 26 students were needed in each condition for the power of the study to be substantiated. Similar studies with a short-term intervention have demonstrated a medium effect size (Quach et al., 2014). Since research shows that individuals practicing mindfulness meditation over time results in improved brain integration (Froeliger et al., 2012), it was assumed that a long-term intervention would result in a large effect size. Students were divided into two groups: the mindfulness group and the control group. The control group consisted of 55 students participating in their regular physical education class. The mindfulness group consisted of 40 students who signed up to participate in the mindfulness yoga elective, as opposed to a typical physical education class. Both groups remained in their respective class for an entire school year.

Allocation to study conditions involved consent from the district's superintendent as well as additional approval from the school's principal, chair of the physical education department, and the three main teachers involved in the study. Prior to receiving consent, an abstract, passive consent and copies of all measures were sent to the principal and approved.

Setting

The participating school is a 4-year public high school on the South Shore of Long Island, near New York City. Approximately 1,000 students attend the school, and 5.9% are eligible for a free or reduced lunch. According to the most recent census data the population is composed of 85.3% White, 13% Hispanic, 3.7% African American, 0.1% Native American, 4.5% Asain, and 4.3% identified as other. The average household income is approximately $86,000, whereas the median household income for New York State is

$58,878. The school has a variety of programs aimed at improving social and emotional learning and the school has expressed specific interest in promoting mindfulness. The school also offers a variety of year-long physical education classes for upper classmen: PE/Co-ed team sport, Adaptive PE, Strength training and conditioning, Owl adventure, Yoga, and Mindfulness yoga.

Measures

Socio-demographic measure. A demographic questionnaire was utilized to assess gender, age, mental health, primary language, GPA, ethnicity, previous experience with mindfulness and level of interest in the curriculum. The questionnaire also identified and consequently excluded students who were not fluent in the English language or who had documented visual impairments. No students reported visual impairments and all participants were fluent in the English language (see Appendix A).

Automated Operation Span Task. The Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005) is a cognitive measure used to assess working memory ability. This computerized task is run by E- prime or Inquisit software and is administered on a computer. It is mouse driven, scores itself, and requires minimal intervention by the experimenter because instructions are delivered on the screen. There are a total of 75 letters to remember and 75 math equations to complete. The task is made up of 15 trials and takes approximately 20 to 25 minutes to finish. Participates are asked to solve a series of math operations while simultaneously attempting to recall a set of unrelated words. To receive credit for each trial, participants are required to provide correct answers for 85% of the equations (Unsworth et al., 2005). Once the task is completed, five scores are generated: Aospan absolute score, total number correct, math errors, speed errors, and accuracy score.

In essence, the Aospan measures the ability to learn and retain novel information while in the presence of distracting stimuli (Engle, 2002). It is a popular choice for working memory research. It has been used extensively with both children and adolescents (Gradisar, Terrill, Johnston, & Douglas, 2008; Kaufman, DeYoung, Gray, Brown, & Mackintosh,

2009). The Aospan has good internal consistency (alpha = .78) and correlates moderately well with the Ospan (r = .45, p = .01), which is the original measure (Turner & Engle, 1989). It is important to note that although both tasks involve processing mathematical operations, these two tasks are not identical. When compared to working memory span measures that have been previously examined, these correlations reveal a similar consistency (Unsworth et al., 2005). In addition, the Aospan is deemed highly reliable across testing sessions. A total of 78 participants were selected from the original population of 296 to estimate test-retest reliability over the span of 173 days (r = .83, p = .01). A Confirmatory Factor Analysis (CFA) was performed using the same population. The CFA looked to assess the working memory capacity factor. According to Unsworth et al. (2005), all fit indices suggested that the model fit was good (Comparative Fit Index (CFI)= .98 and Normative Fit Index (IFI)= .96)

The Mindful Attention Awareness Scale-Adolsecent. The Mindful Attention Awareness Scale-Adolescent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011) is a 14-item measure created on a 6-point Likert scale ranging from 1 (*almost always*) to 6 (*almost never*) and takes under 5 minutes to complete. It has been validated for use with community and clinical population adolescents aged 14-18 years (Brown et al., 2011) (See Appendix D). The MAAS-A stands apart from other measures because it is derived from both historical and contemporary Buddhist scholarship as well as clinical theory and research on the practice and enrichment of mindfulness (Kabat-Zinn, 1990).

The MAAS-A is used to assess mindfulness, which is defined as, “a receptive state of mind in which attention, informed by a sensitive awareness of what is occurring in the present, simply observes what is taking place.” (Brown et al., 2011, p. 1024). It asks adolescents how frequently or infrequently they experience each situation and includes questions like, “I find myself doing things without paying attention.” and “I find it difficult to stay focused on what’s happening in the present.” To score the scale, the examiner computes a mean for the 14 items. Higher scores correspond with greater levels of mindfulness.

The MAAS-A has shown good psychometric properties in initial studies. According to Brown et al. (2011), it has good internal consistency (alpha = .86) and correlates strongly with the Child and Adolescent Mindfulness Measure (CAMM; Greco, Baer, & Smith, 2011) (r = .55, p = .001), which is the alternative mindfulness scale used for the same age group. To assess divergent validity, partial correlations with measures of anxiety were calculated. When compared specifically to the State-Trait Anxiety Inventory (STAI; Spielberger, 1989), after an MBSR style intervention was completed there was a significant correlation (r = -.47, p = .001) at posttreatment. These results show that as mindfulness scores increased anxiety decreased. Validity was further demonstrated when calculated with scales measuring for stress (r = -.56, p = .001), rumination (r = -.28, p = .001), and catastrophizing (r = -.35, p = .001), as per the Dutch version of the MAAS-A (de Bruin, Zijlstra, van de Weijer-Bergsma, Bögels, 2011). In addition, the temporal stability of the scale was examined in an independent sample of 131 adolescents over a 3- to 4-week period (r = .79, p = .0001) (Brown et al., 2011).

Stress. A pulse oximeter, which is a device used to measure heart rate, as well as, the oxygen saturation in blood, was used to assess each student's pulse. It is frequently used in medical settings and relied on heavily by certain practitioners, such as anesthesiologists (Brown, Edworthy, Sneyd, & Schlesinger, 2015). The average human resting heart rate ranges from 60 to 90 beats per minute, while a typical oxygen saturation reading is in the middle to high nineties. A value under 90% is deemed low (Arnold, Fitchett, Howlett, Lonn, & Tardif, 2008).

To evaluate validity, Iyriboz, Powers, Morrow, Ayers, and Landry (1991) utilized a linear regression and found that general oximeter readings significantly correlated with those of ECG readings (r = 0.91, p < 0.001). All available oximeters use the same wavelengths, which equates to consistent results (Alexander, Teller, & Gross, 1989). When the pulse oximeter was first created, it was difficult to obtain an accurate reading if an individual was not completely stationary. Since the advent of the pulse oximeter, technology has improved greatly and the pulse oximeter can now read through motion, which is why it is considered

such a dependable device. To obtain pulse, the pulse oximeter emits both red and infrared light through the participant's finger to a transistor photodetector (Brown et al., 2015; Iyriboz et al., 1991). Limitations exist predominately for those individuals with significant medical conditions, not for subclinical, community samples, like schools with students who are exposed to typical daily stressors (Alexander et al., 1989).

It is suggested that psychological stressors activate a systemic stress response in the autonomic nervous system. This response effects both the central nervous system and peripheral organs. Stress simultaneously activates sympathetic nerves while inhibiting the parasympathetic nervous system (Hasegawa, Hayano, Kawaguchi, & Yamanaka, 2015). A pulse oximeter can detect changes in heart rate, which is a correlate of increased stress. This instrument produces momentary results and was used directly by the student under the supervision of a nurse.

Behavior Probe. A behavioral probe was completed by three of each student's teachers. Two teachers, plus the physical education teacher, was utilized to decrease any potential bias. A single-item questionnaire was distributed to the teachers to better generalize potential results. Teachers indicated on a 6-point Likert scale ranging from 1 (*almost always*) to 6 (*almost never*) each student's capacity for orienting to classroom tasks, which is a vital component of working memory (Adolfsdottir, Sorensen, & Lundervold, 2008). Orienting was operationally defined as: "Is (student's name) aligning his/her attention following your direct requests? For example, is he/she able to follow along when given a specific direction, like silent reading" (see Appendix E). This item was taken from Ponser (1980).

Procedure

Data Collection. In September of 2016 passive letters of consent (Appendix B) were sent home. To increase the likelihood that parents/guardians received the document, the letter was also put on the front page of the parent portal, which is an online tool used to help parents stay well-informed and engaged in their child's education. Parents had the option to withdraw their child from the study at this timepoint and were notified that they had the ability to pull their child out anytime thereafter. Student participants also read and signed the

assent form (see Appendix C). In addition, all participating students completed the demographic questionnaire during baseline data collection, as well as the Mindful Attention Awareness Scale-Adolsecent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011) and the Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005). While completing the self-report measure, each student was instructed on how to obtain a reading from the pulse oximeter. This reading was obtained directly by the student, under the supervision of a nurse. Students were instructed to place the instrument on their index finger so that the device faced them. They were then asked to wait 30 seconds to receive an accurate oxygen saturation and pulse rate reading. The observing nurse recorded student readings on each participant's folder. To ensure the anonymity of all participants, each student was provided with an ID number, which was used throughout the remainder of the study. Also during this time, the behavioral probe was completed by three of each student's teachers (two teachers plus the physical education/mindfulness teacher). With the exception to the demographic questionnaire, all pre-intervention measures were administered again immediately following the conclusion of the intervention in May of 2017 and a follow-up in June of 2017. It is important to note that the researcher and research assistants were solely responsible for data collection. The mindfulness and physical education teachers were not directly involved in data collection. Hopefully this helped to ensure that students did not associate their teachers with the required questionnaires and working memory tasks. It hopefully also decreased reactionary responses and other potential biases (Furnham, 1986).

Mindfulness group. The mindfulness curriculum spanned the entire school year. Other similar interventions have been implemented in under 2 months (Quach et al., 2014). The duration of the curriculum was increased in the current study to strengthen the power of the curriculum. This extension allowed students to have more time to practice and subsequently internalize the attitudinal foundations of mindfulness.

The week after pre-test data were collected, the intervention began. The mindfulness group consisted of students participating in the year-long mindfulness meditation and yoga class. The class was led by a physical education teacher, employed by the school district,

who had also been trained through the University of Massachusetts as a mindfulness meditation teacher. This course was open to students in grades 11 through 12 and met every other school day for approximately 40 minutes. These students engaged in the stress reduction activities of yoga and mindfulness meditation. They explored and engaged in a variety of stress reducing activities for the mind and body, which included yoga postures, meditation, and breathing techniques aimed at improving health and reducing stress. This course was designed for students to understand how to cope with stress and engage in practices that support whole body health. For a sample exercise see Appendix F and for a more detailed intervention timeline, please refer to Table 1.

Table 1

Mindfulness Meditation Curriculum Timeline

Dates	Program Components
September, 2016	**Prerequisites** -Passive consent forms sent home -Pre-test: baseline data collection
October, 2016 (Week 1 and 2)	**Present Moment Awareness** -Awareness of breath -Awareness of body -Mindful awareness: Present moment acknowledgement -Building trust within the group
October, 2016 (Week 3 and 4)	**Experiential Mindfulness** -Training and skill development -The role of perception -Introduction to the role of self-responsibility in health
November, 2016 (Week 1 and 2)	**Cultivating Formal Practices Through the Senses** -The pleasure and power of being present -Attending to and investigating the body and mind in the present moment through the practices of yoga and meditation
November, 2016 (Week 3 and 4)	**The Development of Concentration** -Investigating the" Field of Awareness"
December, 2016 (Week 1 and 2)	**Investigate the ways stress impacts coping patterns, thoughts, emotions and behaviors**
December, 2016 (Week 3 and 4) *Holiday recess (aprox. one week) January, 2017 (Week 1 and 2)	**Communication** -Identifying feelings, expressing feelings and developing a greater awareness of communication patterns
January, 2017 (Week 3 and 4)	**Maintaining and Integrating Formal Mindfulness Practices Into Everyday Routine** -Reflect on life-style choices that are healthy & nourishing vs. unhealthy and self-limiting -Begin to create and design own formal practice

January, 2017 (Week 3 and 4)	**Maintaining and Integrating Formal Mindfulness Practices Into Everyday Routine** -Reflect on life-style choices that are healthy & nourishing vs. unhealthy and self-limiting -Begin to create and design own formal practice
February through May, 2017 *Winter recess (one week off) *Spring recess (one week off)	**Maintaining and Integrating Formal Mindfulness Practices Into Everyday Routine** -Continue to create and design own formal practice -Engage in the stress reduction activities of yoga and mindfulness meditation -Identify resources in the community to further enhance wellness practices -Review all themes presented in the course and apply them to practice
May, 2017 (Week 1)	Post-test: data collection
June, 2017 (Week 1)	Post-test: follow-up data collection

Control group. The control group consisted of students participating in the year-long PE/Co-ed team sport class. The class was led by a physical education teacher employed by the school district. This course was open to students in grades 10 through 12 and met every other school day for approximately 40 minutes. The following are activities that were taught during the school year: adventure education, which is the promotion of learning through adventure centered experiences, basketball, fitness technology, floor hockey, pickle ball, lacrosse, soccer, step aerobics, team handball, weight training, volley ball, racket games, and flag football. It should be noted that yoking was originally expected to be utilized with control group participants to statistically equalize the experiment, but after a pretest *t*-test analysis, this procedure was deemed not necessary. For a side by side comparison of the structure of intervention sessions please refer to Table 2.

Table 2

Structure of Intervention Sessions

Mindfulness Condition	**Physical Education Condition**
3-5 Minutes attendance and set-up 5 Minutes introduction to theme 15-20 Minutes formal practice 10 Minutes closure discussion (October-January Schedule)	2-3 Minutes attendance 5 Minutes warm-up 25 Minute game-play 5 Minutes closure (October-May Schedule)
3-5 Minutes attendance and set-up 2 Minutes re-introduction to theme 20-25 Minutes formal practice 5-10 Minutes closure discussion (February-May Schedule)	

Protection of Human Participants

Before proceeding with the experiment, the procedures utilized in this experiment were approved by Hofstra's Institutional Review Board (IRB). In addition, consent was obtained from the principal of the school and the superintendent of the district.

CHAPTER III

RESULTS

The current study sought to explore the effectiveness of a long-term mindfulness curriculum, modeled from the Mindfulness Based Stress Reduction (MBSR) program and amended to fit the educational and psycho-social needs of adolescents. The study's aim was to analyze the mindfulness curriculum by examining the effects of the intervention on working memory skills, stress, and the ability to be mindful. Results were based upon data collected from 95 students in tenth through twelfth grade who attended a suburban public high school close to New York City. There were 40 students in the mindfulness condition, and 55 students participated in the typical physical education class, which acted as the control group. Two students in the physical education class did not complete pretest data and were subsequently dropped from the study. All remaining students completed pretest data and participated in the study, signifying that no student was dropped from the study after pretest data were finalized. To evaluate individual student change throughout the study, students completed the Mindful Attention Awareness Scale-Adolescent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011). Students also completed the Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005), and their pulses were read by a pulse oximeter. Additionally, each student was assessed by three teachers to decipher whether working memory skills showed posttreatment improvement in a variety of academic domains. Each measure was completed at pretest (T1), posttest (T2), and 1-month follow-up (T3). Nine hypotheses were examined in the current study. Treatment integrity, data screenings, scale psychometrics, descriptive statistics, main and ancillary findings are discussed below.

Treatment Integrity

The researcher insured treatment integrity by creating a fidelity checklist (see Appendix G). The fidelity checklist was utilized by the researcher, two outside integrity evaluators and the mindfulness instructor responsible for teaching the experimental group. The mindfulness instructor completed the checklist after each school week. Due to the

limited number of qualified mindfulness instructors on Long Island, only a few individuals were eligible to evaluate treatment integrity. The mindfulness instructor, researcher, and two other outside integrity evaluators all completed mindfulness training through the University of Massachusetts's MBSR program. The researcher and other outside integrity evaluators made spontaneous trips to observe instruction of the experimental group. These three individuals each visited the experimental group on two to three separate occasions, for a total of seven observations. Results of the fidelity checklist indicated that the curriculum was completed precisely as prescribed. All individuals completing the checklist confirmed this finding with 100% accuracy. In addition, the researcher and teacher volunteers were solely responsible for distribution of the measures to ensure that the students did not associate the teacher with the study. This precaution hopefully prevented students from altering answers to please their teacher.

Data Screening

Before running any main analyses, data were screened. A single outlier was identified at pretest. Analyses were run with and without the outlier and because the outlier posed no difference to results it was included (C. Dill, personal communication, June 26, 2017). No outliers were found at T2 or T3. A z-test was applied for normality testing using skewness and kurtosis. All variables fell within the normal range, indicating that the distribution of the samples were normal (Kim, 2013). The researcher allotted two opportunities each time data were collected to protect against student absences. No students were absent during T1- T3 data collection. Although no students were absent, two individuals were present and refused to participate. The individuals who chose to abstain were subsequently dropped from the study.

Descriptive Statistics

A summary of the descriptive statistics for each condition is displayed in Table 3 while Table 4 shows a summary of means and standard deviations for all measures across groups at each time point.

Table 3

Frequency Data of Demographic Variables across Conditions

Demographic Variable	Mindfulness Class N (%)	Physical Education N (%)	Total N (%)
Gender			
Male	4 (10.0%)	26 (47.3%)	30 (31.6%)
Female	36 (90.0%)	29 (52.7%)	65 (68.4%)
Age			
14	0 (0.0%)	6 (10.9%)	6 (6.3%)
15	4 (10.0%)	27 (49.1%)	31 (32.6%)
16	15 (37.5%)	18 (32.7%)	33 (34.7%)
17	21 (52.5%)	4 (7.3%)	25 (26.3)
Fluent in English			
Yes	40 (100.0%)	55 (100.0%)	95 (100.0%)
No	0 (0.0%)	0 (0.0%)	0 (0.0%)
Visual Impairment			
Yes	0 (0.0%)	0 (0.0%)	0 (0.0%)
No	40 (100.0%)	55 (100.0%)	95 (100.0%)
GPA			
A (100-90)	28 (70.0%)	37 (67.3%)	65 (68.4%)
B (89-80)	11 (27.5%)	16 (29.1%)	27 (28.4%)
C (79-70)	1 (2.5%)	2 (3.6%)	3 (3.2%)
D (69-60)	0 (0.0%)	0 (0.0%)	0 (0.0%)
F (Below 60)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Race/Ethnicity			
African/African American	0 (0.0%)	0 (0.0%)	0 (0.0%)
Latino/Hispanic	7 (17.5%)	4 (7.3%)	11 (11.6%)
Asian/Asian American	0 (0.0%)	5 (9.1%)	5 (5.3%)
Biracial	2 (5.0%)	1 (1.8%)	3 (3.2%)
Caucasian/European	31 (77.5%)	42 (76.4%)	73 (76.8%)
Native American/Pacific Islander/Eskimo	0 (0.0%)	1 (1.8%)	1 (1.1%)
Other	0 (0.0%)	2 (3.6%)	2 (2.1%)
Interest in Mindfulness Meditation			
Not at all interested	0 (0.0%)	7 (12.7%)	7 (7.4%)
Not very interested	2 (5.0%)	11(20.0%)	13 (13.7%)

Neutral	10 (25.0%)	20 (36.4%)	30 (31.6%)
Somewhat interested	14 (35.0%)	13 (23.6%)	27 (28.4%)
Very Interested	14 (35.0%)	4 (7.3%)	18 (18.9%)
Experience with Mindfulness Meditation			
Never tried	11 (27.5%)	20 (36.4%)	31 (32.6%)
Tried once or twice	17 (42.5%)	25 (45.5%)	42 (44.2%)
A few times per year	4 (10.0%)	6 (10.9%)	10 (10.5%)
A few times per month	5 (12.5%)	1 (1.8%)	6 (6.3%)
A few times per week	3 (7.5%)	3 (5.5%)	6 (6.3%)
Daily practice	0 (0.0%)	0 (0.0%)	0 (0.0%)
Potential Benefit from Mindfulness Meditation			
No benefit	0 (0.0%)	1 (1.8%)	1 (1.1%)
Not much benefit	0 (0.0%)	6 (10.9%)	6 (6.3%)
Neutral	10 (25.0%)	17 (30.9%)	27 (28.4%)
Some benefit	13 (32.5%)	25 (45.5%)	38 (40.0%)
A lot of benefit	17 (42.5%)	6 (10.9%)	23 (24.2%)

Table 4

Means and Standard Deviations across Conditions

Outcome	Mindfulness *M (SD)*	Physical Education *M (SD)*
MAAS-A		
T1	3.13 (.682)	4.14 (.730)
T2	3.51 (.761)	4.05 (.849)
T3	3.60 (.843)	3.97 (.832)
AOSPAN		
T1	34.55 (13.160)	39.49 (13.409)
T2	41.60 (13.735)	42.69 (16.484)
T3	43.45 (12.428)	41.75 (16.811)
Pulse		
T1	78.90 (11.160)	78.29 (12.069)
T2	72.13 (9.18)	81.75 (12.57)
T3	74.12 (7.021)	82.25 (12.728)
Behavior Probe		
T1	2.04 (.713)	1.77 (.652)
T2	1.35 (.505)	1.58 (.612)
T3	1.28 (.492)	1.61 (.595)

Note. M = mean; *(SD)* = standard deviation; MAAS-A = Mindful Attention Awareness Scale for Adolescents; AOSPAN = Automated version of the Operation Span Task; Pulse = reading from a pulse oximeter; Behavior Probe = single-item response gathered from 3 teachers used to quantify observable working memory skills. For the MAAS-A and AOSPAN, higher scores are indicative of more developed responding. For Pulse and Behavior Probe, lower scores are indicative of more developed skills. T = time of measurement; T1 = pretest data collection; T2 = posttest data collection; T3 = follow-up data collection.

Manipulation Checks

The original physical education class consisted of 76 students. Of these 76 students, 21 of them completed a health class instructed by the same teacher who taught the mindfulness class. The health class was infused with some of the same topics that were taught to the mindfulness class, and it was therefore deemed a conflicting variable. The 21 students were consequently removed from the study.

Because of the discrepancy in number of males ($N = 26$) verses females ($N = 29$) in the physical education class and males ($N = 4$) verses females ($N = 36$) in the mindfulness class, an independent samples *t*-test at pre-test was conducted to assess potential differences. No significant differences were found between males and females when examining GPA, potential benefit (which was operationalized by a question that asked if participants thought that they would benefit from a program that taught them how to become more mindful), level of interest (which was operationalized by a question that asked participants about their current level of interest in mindfulness meditation), amount of experience (which was operationalized by a question that asked participants about their level of previous experience with mindfulness meditation), pulse readings, behavioral probe responses (i.e., the mean score from three teachers indicating the level of attentiveness displayed by each participant, AOSPAN (i.e., working memory) and MAAS-A (i.e., mindfulness) scores. Therefore, there was no need to yoke participants in the physical education class. Yoking is needed when there are statistical differences between the experimental and control groups. To utilize yoking, the researcher must observe the type of responding exhibited by participants in the experimental group and compared it to individuals in the control group. The individuals in the control group are then matched with the experimental group participants. This is done to help confirm that subsequent variations in responding are due to the intervention and not a cofounding variable.

Psychometrics

The MAAS-A demonstrated good internal consistency at T1 with an alpha of .90. Good internal consistency was also exhibited at T2 and T3 with an alpha of .91. The moderator variable for motivation was calculated by taking the mean score of two questions in the demographic questionnaire; each question was presented on a Likert scale ranging from 1 *(not at all)* to 5 *(a lot).* After defining mindfulness as, "The ability to pay attention in the current moment without judging or thinking too much about it," the first question asked, "Do you think you would benefit from a program that taught you how to become more mindful?" The second question inquired, "What is your amount of interest in mindfulness meditation?" This scale also demonstrated good internal consistency with an alpha of .70 at all three time points. All other measures utilized single variable scores.

Main Findings

Mindfulness

Hypothesis one. It was hypothesized that students who received the mindfulness curriculum would report increased levels of mindfulness at T2 and T3, compared to students who were in the physical education class. An ANCOVA, where MAAS-A scores at T1 served as the covariate, and MAAS-A scores at T2 and T3 served as the dependent variable was conducted. Results indicated that adolescents who received the mindfulness curriculum ($M = 3.51$, $SD = 0.761$), compared to the physical education class ($M = 4.05$, $SD = 0.849$), did not report significantly more mindfulness at T2, $F\ (1, 92) = .175$, $p = .68$, η_p^2 .002. Furthermore, results indicated that adolescents who received the mindfulness curriculum ($M = 3.60$, $SD = 0.843$), compared to the physical education class ($M = 3.97$, $SD = 0.832$), did not report significantly more mindfulness at T3, $F(1, 92) = 1.45$, $p = .23$, η_p^2 .016. (See Figure 1 for trends in data)

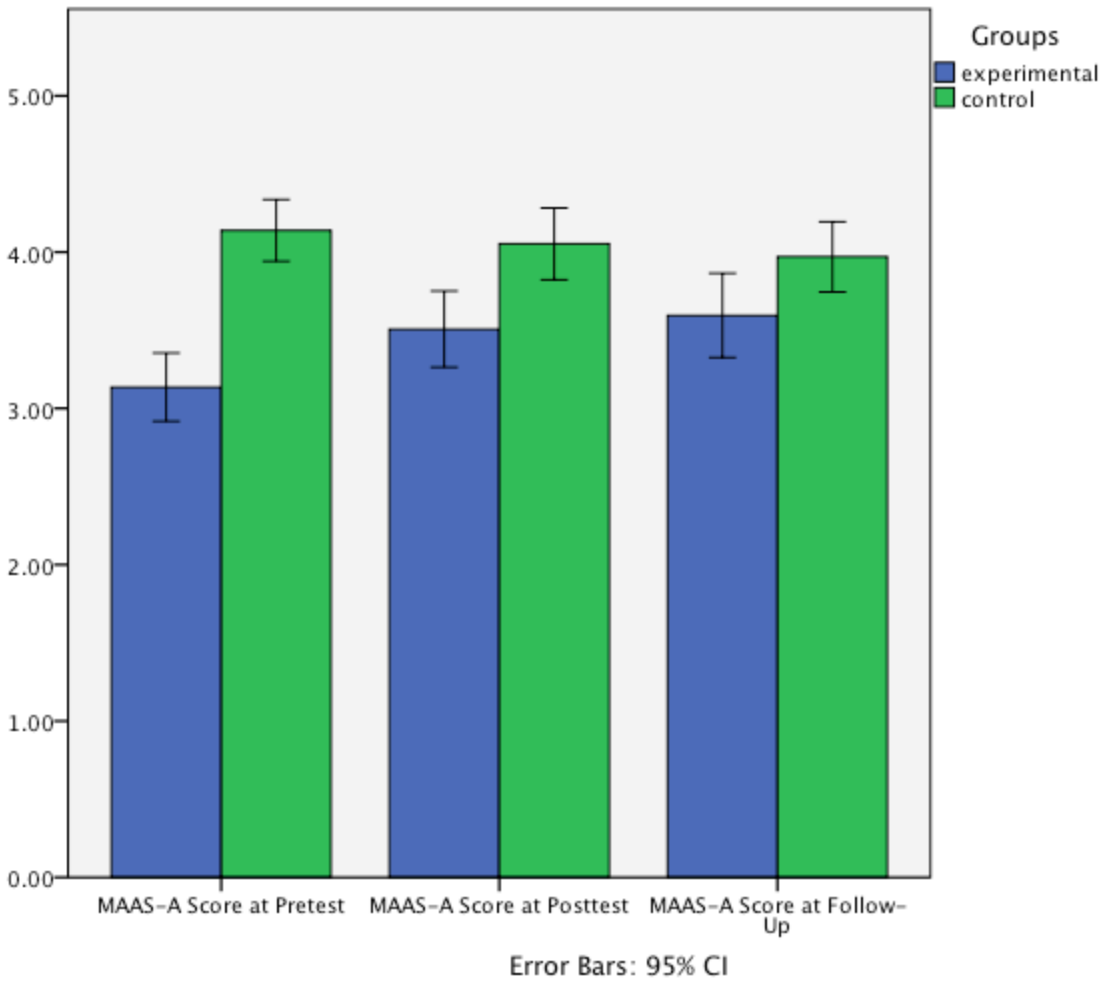

Figure 1. Mean MAAS-A scores across conditions and timepoints.

Note. MAAS-A = Mindful Attention Awareness Scale-Adolescent. Higher scores are indicative of more developed responding. T1 = pretest data collection; T2 = posttest data collection; T3 = follow-up data collection.

Stress

Hypothesis two. It was hypothesized that students who received the mindfulness curriculum would report decreased levels in autonomic stress response, as measured by a pulse oximeter, at T2 and T3, compared to students who were in the physical education class. An ANCOVA, where pulse readings at T1 served as the covariate, and pulse readings at T2 and T3 served as the dependent variable was conducted. Results indicated that adolescents who received the mindfulness curriculum (M = 72.13, SD = 9.180), compared to the physical education class (M = 81.75, SD = 12.566), demonstrated significantly lower pulse rates at T2, F (1, 92) = 25.24, $p < .001$, η_p^2 .215. Furthermore, results indicated that adolescents who received the mindfulness curriculum (M = 74.12, SD = 7.021), compared to the physical education class (M = 82.25, SD = 12.728), also demonstrated significantly lower pulse rates at T3, F(1, 92) = 24.97, $p < .001$, η_p^2 .213, both resulting in medium to large effect sizes (see Figure 2).

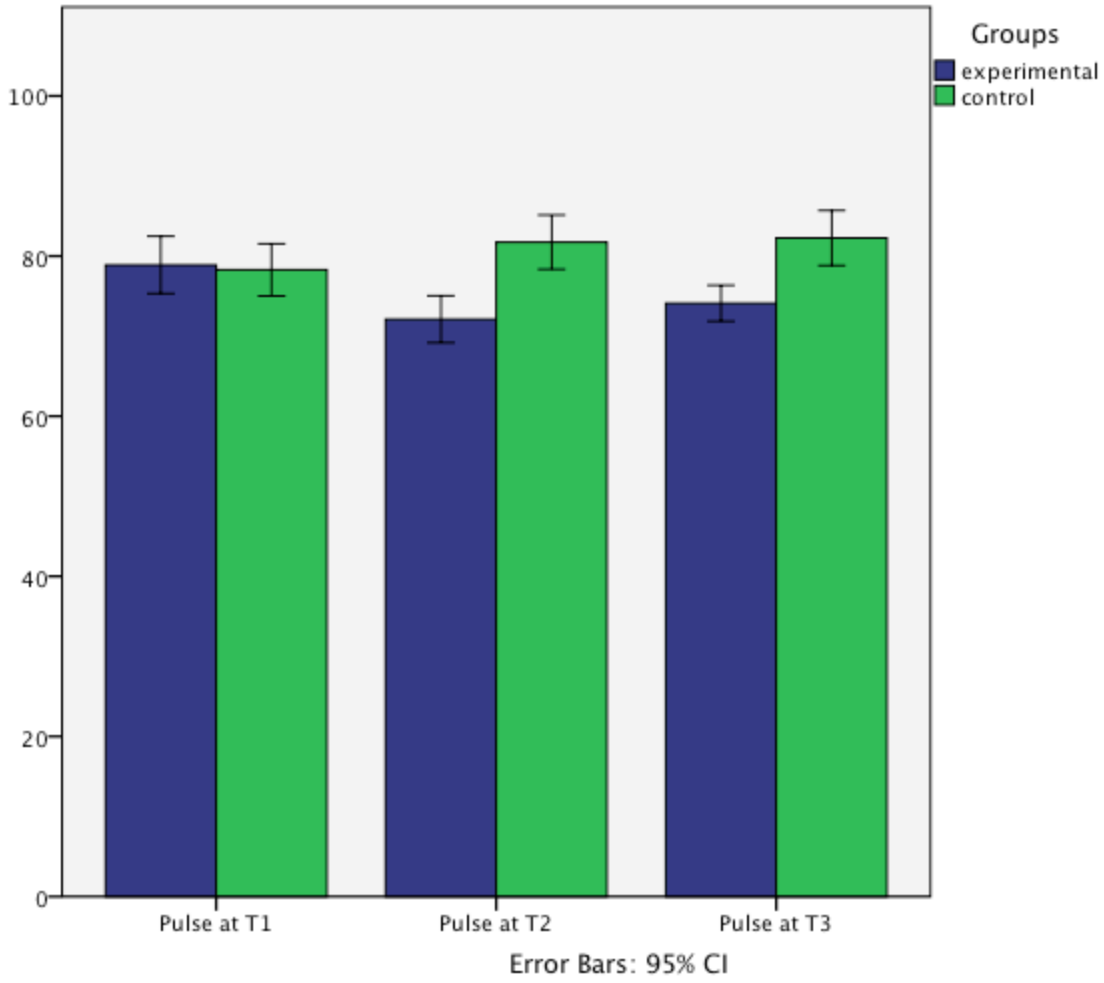

Figure 2. Mean of pulse readings across conditions and timepoints.

Note. Pulse = reading from a pulse oximeter. Lower scores are indicative of less stress. T1 = pretest data collection; T2 = posttest data collection; T3 = follow-up data collection.

Working Memory

Hypothesis three. It was hypothesized that students who received the mindfulness curriculum would report increased levels of working memory as measured by the AOSPAN, at T2 and T3, compared to students who were in the physical education class. An ANCOVA, where AOSPAN scores at T1 served as the covariate, and AOSPAN scores at T2 and T3 served as the dependent variable was conducted. Results indicated that adolescents who received the mindfulness curriculum ($M = 41.60$, $SD = 13.735$), compared to the physical education class ($M = 42.69$, $SD = 16.484$), did not demonstrate significantly higher working memory skills at T2, $F\ (1, 92) = 1.81$, $p = .18$, η_p^2 .019. Conversely, results indicated that adolescents who received the mindfulness curriculum ($M = 43.45$, $SD = 12.428$), compared to the physical education class ($M = 41.75$, $SD = 16.811$), demonstrated significantly higher working memory skills at T3, $F(1, 92) = 7.35$, $p < .01$, η_p^2 .074), indicating a delayed treatment effect with a small to medium effect size (see Figure 3).

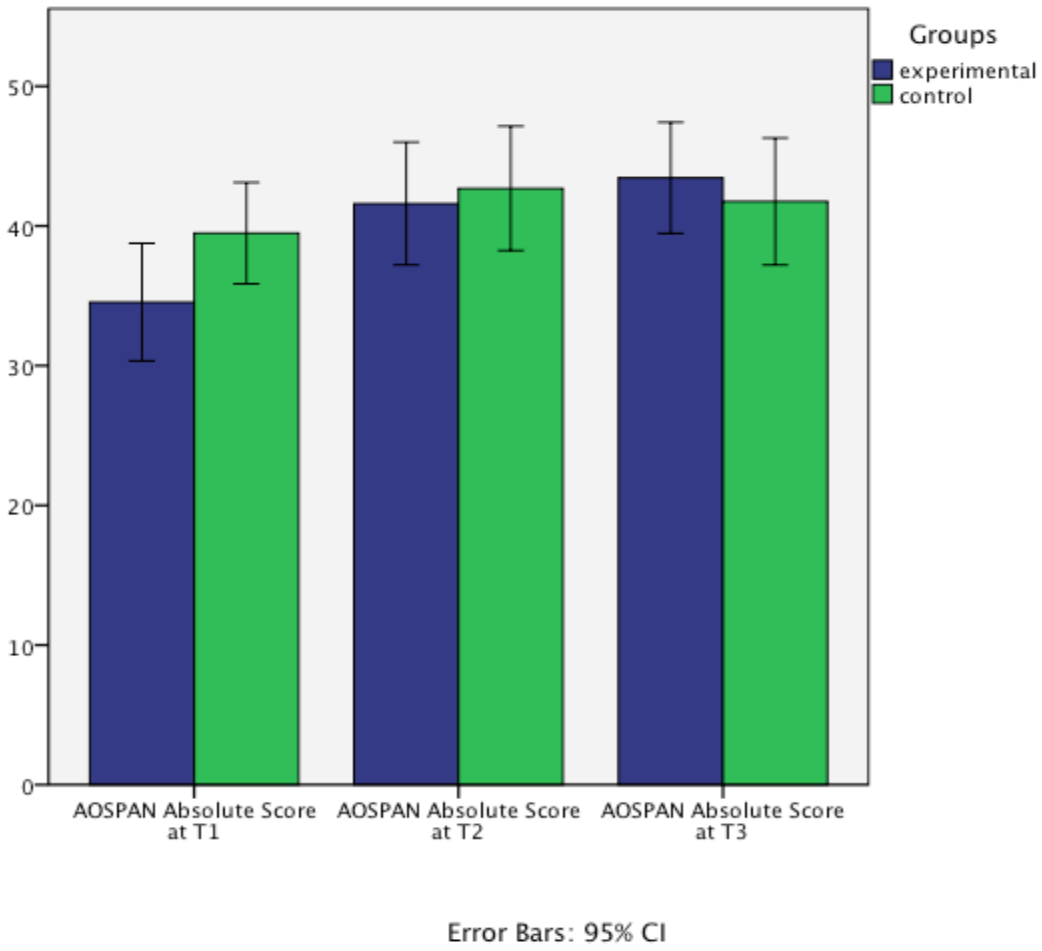

Figure 3. Mean AOSPAN absolute scores across conditions and timepoints.

Note. AOSPAN = Automated version of the Operation Span Task. Higher scores are indicative of more developed responding. T1 = pretest data collection; T2 = posttest data collection; T3 = follow-up data collection.

Secondary Findings

Moderators

To run the moderator analyses, the Process add-on software for SPSS version 2.13 developed by Hayes (2013) was utilized. The add-on software was responsible for centering the moderator variables; calculating interaction terms from the centered independent and moderator variables; conducting simple moderation analyses, which encompassed pre-test scores of the independent variable as a covariate; and using the Johnson-Neyman method to probe an interaction if it was statistically significant. Additionally, heteroscedasticy-consistent estimators were used in calculating standard errors (Field, 2013).

Hypothesis four. It was hypothesized that students who were highly motivated to use mindfulness meditation and who received the mindfulness curriculum would benefit the most from the intervention. As previously mentioned, motivation was calculated by taking the mean of the potential benefit and interest scores. There was no evidence for a significant moderator effect. Thus, motivation did not moderate the findings ($R2$=. 002, $F(1,90)$ =.247, p =.620).

Hypothesis five. It was hypothesized that students who had the most previous experience with mindfulness meditation and who received the mindfulness curriculum would benefit the most from the intervention. Previous experience was garnered from a single question on the demographic questionnaire. There was no evidence for a significant moderator effect. Thus, previous experience with mindfulness meditation did not moderate the findings ($R2$=. 020, $F(1,90)$ =1.652, p =.202).

Hypothesis six. It was hypothesized that students who had the highest GPA and who received the mindfulness curriculum would benefit the most from the intervention. GPA was obtained from a self-report item on the demographic questionnaire. There was no evidence

for a significant moderator effect. Thus, GPA did not moderate the findings (*R2*=. 035, *F*(1,90) =3.909, *p* =.051).

Hypothesis seven. It was hypothesized that students who demonstrated the least amount of stress and who received the mindfulness curriculum would benefit the most from the intervention. Stress was measured by pulse readings on a pulse oximeter. There was no evidence for a significant moderator effect. Thus, pulse rates did not moderate the findings (*R2*=. 004, *F*(1,90) =.417, *p* =.520).

Hypothesis eight. It was hypothesized that students who had the highest working memory scores and who received the mindfulness curriculum would benefit the most from the intervention. Working memory was measured by scores obtained from the computerized working memory task (AOSPAN). There was no evidence for a significant moderator effect. Thus, working memory did not moderate the findings (*R2*=. 006, *F*(1,90) =1.010, *p* =.315).

Hypothesis nine. It was hypothesized that students who demonstrated the least amount of stress and who received the mindfulness curriculum would have the highest working memory scores. As previously noted, stress was measured by pulse readings on a pulse oximeter and working memory was measured by scores obtained from the computerized working memory task (AOSPAN). There was no evidence for a significant moderator effect. Thus, pulse rates did not moderate the findings (*R2*=. 001, *F*(1,90) = .170, *p* =.681).

Additional Analyses

It was hypothesized that when students received the mindfulness curriculum, their teachers would report increased levels of working memory, at T2 and T3, compared to students who were in the physical education class. Working memory was measured by a behavior probe. Three teachers completed a single-item response and the mean of their scores was used to quantify observable working memory skills for each individual

participant. An ANCOVA, where behavioral probe scores at T1 served as the covariate, and behavioral probe scores at T2 and T3 served as the dependent variable was conducted. Results indicated that when adolescents received the mindfulness curriculum (M = 1.35, SD = 0.505), compared to the physical education class (M = 1.58, SD = 6.112), their teachers reported significantly higher working memory skills at T2, F (1, 92) = 10.92, $p < .001$, η_p^2 .106. Furthermore, results indicated that when adolescents received the mindfulness curriculum (M = 1.28, SD = 0.492), compared to the physical education class (M = 1.62, SD = 0.595), their teachers reported significantly higher working memory skills at T3, F(1, 92) = 17.12, $p < .001$, η_p^2 .157), both results indicating a medium to large effect size (see Figure 4).

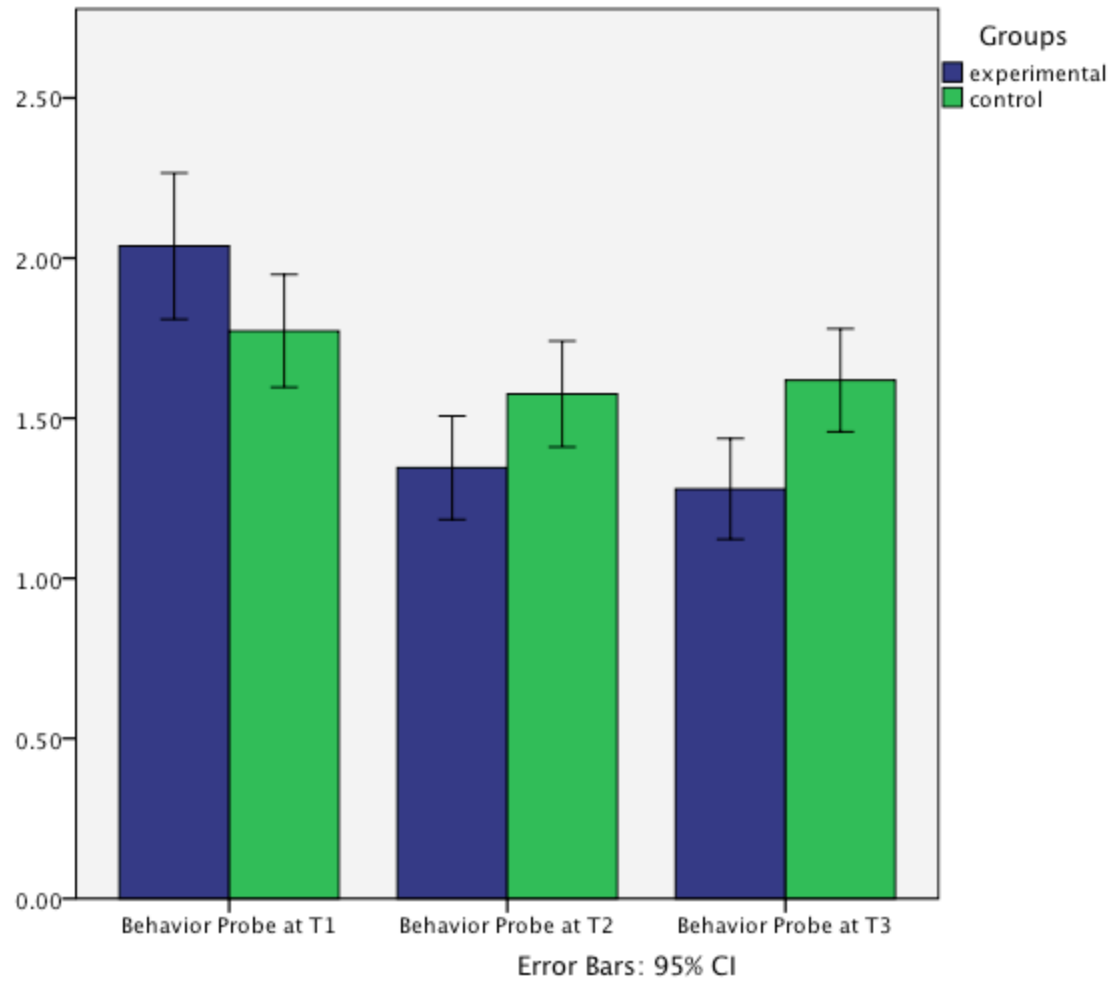

Figure 4. Mean scores of behavior probe across conditions and timepoints.

Note. Behavior Probe = single-item response gathered from 3 teachers used to quantify observable working memory skills. Lower scores are indicative of more developed skills. T1 = pretest data collection; T2 = posttest data collection; T3 = follow-up data collection.

To further analyze the data and interpret potential indirect effects, a mediator model was employed. Specifically, a bootstrapping with replacement, bias-corrected and accelerated procedure was utilized (5,000 samples of $N = 95$). Bootstrap methods rely on random sampling with replacement, also known as resampling. Bootstrapping is a type of metric that assesses variation and mean accuracy directly from a sizeable population of statistical estimations (Champagne, McNairn, Daneshfar, & Shang, 2014). Bootstrapping was chosen because the Baron and Kenny (1986) step-wise approach is deemed less reliable with smaller sample sizes, as seen in this study (Froh, Bono, & Emmons, 2010).

Bootstrapped estimates were used to assess the indirect effect of mindfulness at T2 on stress at T2, after controlling for stress at T1. There was no statistically significant indirect effect. The difference between the total and direct effects is the total indirect effect through the mediator with a point estimate of .04 and a 95% BCa (bias corrected and accelerated) bootstrap CI (confidence interval) of -1.27 through 1.50. Eight additional analyses were run, all showing no statistical significance. The indirect effect of mindfulness at T2 on stress at T3, after controlling for stress at T1 was assessed (b = -.16, BCa CI [-1.55, .94]). The indirect effect of mindfulness at T3 on stress at T3, after controlling for stress at T1 was assessed (b = -.37, BCa CI [-1.49, 2.01]). The indirect effect of mindfulness at T2 on working memory at T2, after controlling for working memory at T1 was assessed (b = .30, BCa CI [-1.31, 2.07]). The indirect effect of mindfulness at T3 on working memory at T2, after controlling for working memory at T1 was assessed (b = -.42, BCa CI [-1.00, 2.41]). The indirect effect of mindfulness at T3 on working memory at T3, after controlling for the behavior probe at T1 was assessed (b = -.03, BCa CI [-1.19, 1.05]). The indirect effect of mindfulness at T2 on the behavior probe T2, after controlling for the behavior probe at T1 was assessed (b = .04, BCa CI [-.03, .15]). The indirect effect of mindfulness at T3 on the behavior probe at T2, after controlling for the behavior probe at T1 was assessed (b = -.06,

BCa CI [-.16, .01]). Finally, the indirect effect of mindfulness at T3 on the behavior probe at T3, after controlling for the behavior probe at T1 was assessed (b = -.03, BCa CI [-.11, .01]). Together, these mediation analyses suggest that mindfulness does not explain the statistically significant findings.

Overall, the mindfulness curriculum was examined in terms of its effectiveness with increasing working memory and mindfulness skills, lowering stress, and maintaining focus in the classroom setting. The mindfulness curriculum resulted in decreased levels of stress and enabled more focus in the classroom. Mindfulness skills did not show significant improvement. The mindfulness curriculum resulted in improvements in working memory skills at 1-month follow-up (T3), but not at the immediate posttest (T2). This discrepancy and others leaves room for additional questions and the need to explore other variables when implementing a mindfulness curriculum with the adolescent population. This will be investigated in greater detail in the discussion section.

Chapter IV

Discussion

Mindfulness is the ability to pay attention to the current moment without preconceived notions or expectations; it is being present with a sense of "heartfulness" (Kabat-Zinn, 2003). Mindfulness involves becoming sensitive to both internal and external stimuli while concomitantly suspending judgement. It is thinking about thinking or the process of becoming familiar with the internal workings of one's consciousness. Mindfulness is considered a process as well as an outcome and is therefore a difficult construct for some to conceptualize.

The ability to be mindful is inherent. All individuals have the capacity to attend to the present moment when motivated to do so. Therefore, all individuals can benefit from the quality of consciousness that mindfulness elicits. This heightened sense of alertness enables people to appreciate moment to moment experiences and bolsters overall well-being, which may be why it is becoming so prevalent (Brown & Ryan, 2003).

Mindfulness is popular with clinical and community samples. Mindfulness invites its practitioners to engage with the present moment nonjudgmentally, with a sense of curiosity instead of fear or doubt. In this way mindfulness can effectively counter the effects of excessive orientation toward the past or future when dealing with stressors (Hofmann, Sawyer, Witt, & Oh, 2010). The practice of mindfulness-based interventions has been associated with a myriad of positive outcomes. This is especially true when using the most rigorously tested mindfulness program, MBSR. The largest meta-analytical effect sizes garnered from MBSR programs are seen when looking at anxiety and mood disorders. Medium to small effect sizes have been recorded in treatment of physical ailments, such as chronic pain, sleep disorders, HIV, and heart disease (Shonin et al., 2014).

Working memory is another construct which is gaining attention exponentially. Working memory is part of a larger system known as executive functioning, which is a comprehensive construct made up of a variety of higher-order neural networks that allows humans to engage in novel problem solving approaches (Suchy, 2009). In addition, working memory facilitates intricate planning strategies and regulates emotional responses to maintain goal-oriented behavior (Williams, Suchy, & Rau, 2009).

There are many positive outcomes associated with school-based mindfulness interventions aimed specifically at improving working memory skills. One study used a randomized controlled design to explore the effects of a 12-week mindfulness-based Kindness Curriculum (KC) given to students in a public-school setting. Results indicated significant overall effects favoring the KC group on measure of working memory, defined as cognitive flexibility (Flook, Goldberg, Pinger, & Davidson, 2015). Another study provided elementary school students with a social and emotional learning (SEL) program, focusing on mindfulness. This curriculum was based on the MindUp program and consisted of 12 lessons. Compared to the control group, upon completion of the curriculum, students in the experimental group showed significant improvement in working memory, which was defined by cognitive control (Schonert-Reichl et al., 2015).

There is only a single known study to date that has attempted to improve high school student's working memory skills through a modified MBSR curriculum. The short-term intervention implemented by Quach et al. (2014) demonstrated that acquiring mindfulness skills correlates with significant improvement in working memory functioning for high school students. The current study went beyond these variables to include more objective assessment tools (i.e. pulse oximeter) and outside perspectives (i.e. behavior probes), along with the self-reports and computerized tasks. In addition, the intervention was dramatically elongated and longitudinal impact was examined. To advance the literature further, this

current study aimed to evaluate the feasibility of implementing a long-term mindfulness intervention in an academic setting while assessing the effectiveness of this curriculum on working memory, stress, and mindfulness, in a community sample of adolescents. Additionally, the broader purpose was to expand our current knowledge of mindfulness interventions and the potential benefits for school-aged individuals. Many of the hypotheses were supported by the data, which will be discussed below.

Discussion of Main Hypotheses

Hypothesis one. It was hypothesized that that students who participated in the year-long mindfulness group would show a significant increase in mindfulness skills, as measured by The Mindful Attention Awareness Scale-Adolescent (*MAAS-A*; Brown, West, Loverich, & Biegel, 2011), relative to the physical education group, controlling for pre-test, at T2 through T3. Results did not support this hypothesis, as there was no statistical difference between conditions at T2 or T3.

The MAAS-A measures mindfulness as a trait, or inherent personal characteristic. This is difficult to measure because only through observing alterations in cytoarchitecture, which can be done by taking small segments of the brain and using staining agents to reveal neural density (Leahy, Radhakrishnan, & Srinivasan, 2013), can we see incremental improvements in mindfulness throughout developmental stages. At this time, there are no studies that use cytoarchitectonics with children or adolescents, leaving researchers to use more subjective measures.

Grossman (2011) reports that there is much debate about using self-reports to measure the complex and individual's traits of mindfulness. He argues that this is the reason why, when compared to other constructs, there is limited convergent validity. Since mindfulness is a mental process, it is difficult to measure. Recent researchers have developed

breathing counting to behaviorally assess mindfulness. It is deemed reliable and correlates with self-report measures (Levinson, Stoll, Kindy, Merry, & Davidson, 2014). This assessment is promising; however, it is more time consuming and very expensive. Thus, it is not currently feasible in a school setting.

As mentioned above, the post-treatment results assessing mindfulness skills were non-significant, however noteworthy trends were seen in the data. For example, the physical education group had the highest mindfulness scores at T1 (M = 4.14; SD = .730) vs (M = 3.14; SD = .682). These differences showed so much disparity that they demonstrated a significant pretest difference ($p < .01$). Although the physical education class still scored slightly higher, the gap was much smaller at T3 (M = 3.97; SD = .832) vs (M = 3.60; SD = .843). The physical education class showed marked variability, and scores decreased, though not significantly, from T1-T3. Conversely, the mindfulness education class saw a steady improvement of scores from T1 to T3 {(M = 3.14; SD = .682). (M = 3.51; SD = .761), (M = 3.60; SD = .843), again, though not significantly.

Research consistently notes that the process of embodying a sense of mindfulness takes years, even decades to cultivate (Gunaratana, 2011). When the mind intrinsically focuses on feeling into the internal sensations of the body and fully engages with the senses, stillness arises. Only through this place of stillness, it is possible to truly see both the internal and external world. From this state of hyperawareness comes a sense of embodiment.

The data trends in the current study are promising. After treatment refinement, future studies may find significant improvements in level of mindfulness; however, it may be necessary to elongate the curriculum further to observe significant differences in inherent mindfulness. This may be impractical in some settings, but it is recommended. Internalizing a sense of mindfulness is a long and arduous process that does not happen over a short period of time.

Addressing issues with self-reporting is one way to refine the current study. Self-reports, like the *MAAS-A,* are a common research tool because they are typically convenient, nonobtrusive and easy to administer, but their use does not come without risks. Self-reports cannot consider every nuanced personality variable like honesty or image management, which can greatly affect responding (Roese, & Olson, 2007). Social desirability bias is another issue commonly seen in self-reporting. This type of response bias includes the tendency of participants to answer questions in ways that will be perceived favorably by others. It can include reporting an excess of desirable behavior or withholding reports of undesirable behavior (Prince et al., 2008).

In long-term studies, the developmental validity of a self-report measure is crucial for the adolescent population. As mentioned prior, adolescence is the time for dramatic brain development in the prefrontal cortex, which is responsible for developing abstract reasoning skills (Siegel, 2013). It is not possible to ensure that the ability to understand and respond to abstract questions does not change over time and response style may be altered consequently. (Woolley, Bowen, & Bowen, 2004; Woolley, Bowen, & Bowen, 2006). The items that comprise the MAAS-A do not have the most contemporary language, which may be confusing, especially for adolescents. Future researchers may benefit from creating a scale with more modern-day language. For example, instead of, "I find it difficult to stay focused on what's happening in the present.," "I find it difficult to stay focused on what's happening right now." Another example may include, instead of, "I snack without being aware that I'm eating.," "I eat while doing other activities (i.e texting/playing video games/driving)." Adolescent speech is stylistically characterized as a "high involvement style," (Anderson, 2001) which is why including examples, like in the sample questions above, is in better alignment with adolescent verbiage and therefore more relatable for the typical adolescent.

Concomitantly, introspective ability can affect response style as well. The mindfulness group was taught to practice self-reflection, while the physical education group received no such lessons. Due to the emphasis on contemplation taught only to mindfulness

group, the two groups may have differed in their abilities to utilize introspection. The mindfulness group may have been more stringent with their response style, resulting in lower scores. This variable was not adequately addressed and may have subsequently altered findings.

The face-paced nature of today's society has resulted in the rise of rushing and multi-tasking, neglecting time for contemplation and self-reflection. Attempting to finish tasks as quickly as possible and engaging in multiple activities at one time has become common place (Mandossian, 2017). Trying to fit so many things into a limited timeframe does not come without consequence. According to Cook and Dunifon, (2012) less families sit down to eat meals together. Instead, people are eating while driving or snacking periodically throughout the day. This mindless behavior creates a disconnect between mind and body, leaving little room for awareness or circumspection. When an individual is introduced to the topic of mindfulness, the shift in awareness can be intense. The students in the physical education class were not taught about self-reflection and, therefore, may not have seen their actions as lacking mindful attention. For example, the commonplace nature of rushing or eating on the go may have normalized mindless behavior and consequently influenced student responses to questions like: "I snack without being aware that I'm eating." or "I rush through activities without being really attentive to them." This may be especially true for a more nuanced question like, "I tend not to notice feelings of physical tension." An individual who is not practicing mindfulness may not be able to adequately answer this question because the lack of mind-body attunement leaves no room for discernment of bodily tension. In contrast, students participating in the mindfulness class, may have experienced the intense shift in awareness and may have been more able to accurately identify their ability to be mindful, resulting in significant between group discrepancies.

Furthermore, during validity testing, MAAS–A results have demonstrated that male adolescents typically produce slightly higher scale scores than their same-age female peers (Brown et al., 2011). There was a large discrepancy in the number of males ($N = 26$) verses females ($N = 29$) in the physical education class and males ($N = 4$) verses females ($N = 36$) in

the mindfulness group. The males in both the physical education and mindfulness group scored higher than their female counterparts at T1-T3; please refer to figures 5 and 6 for a visual display. The males in the mindfulness group scored significantly higher than the females at T3. Please refer to Table 5 for a detailed description. The discrepancy between males vs females participants may have contributed to the lack of significant. There may have been too much focus on MAAS-A scores without adequately taking gender into account. Had the number of male and female students in each group been more balanced, there may not have been significant differences at baseline. As a result, it is possible that the intervention, and not gender, could have altered MAAS–A scores.

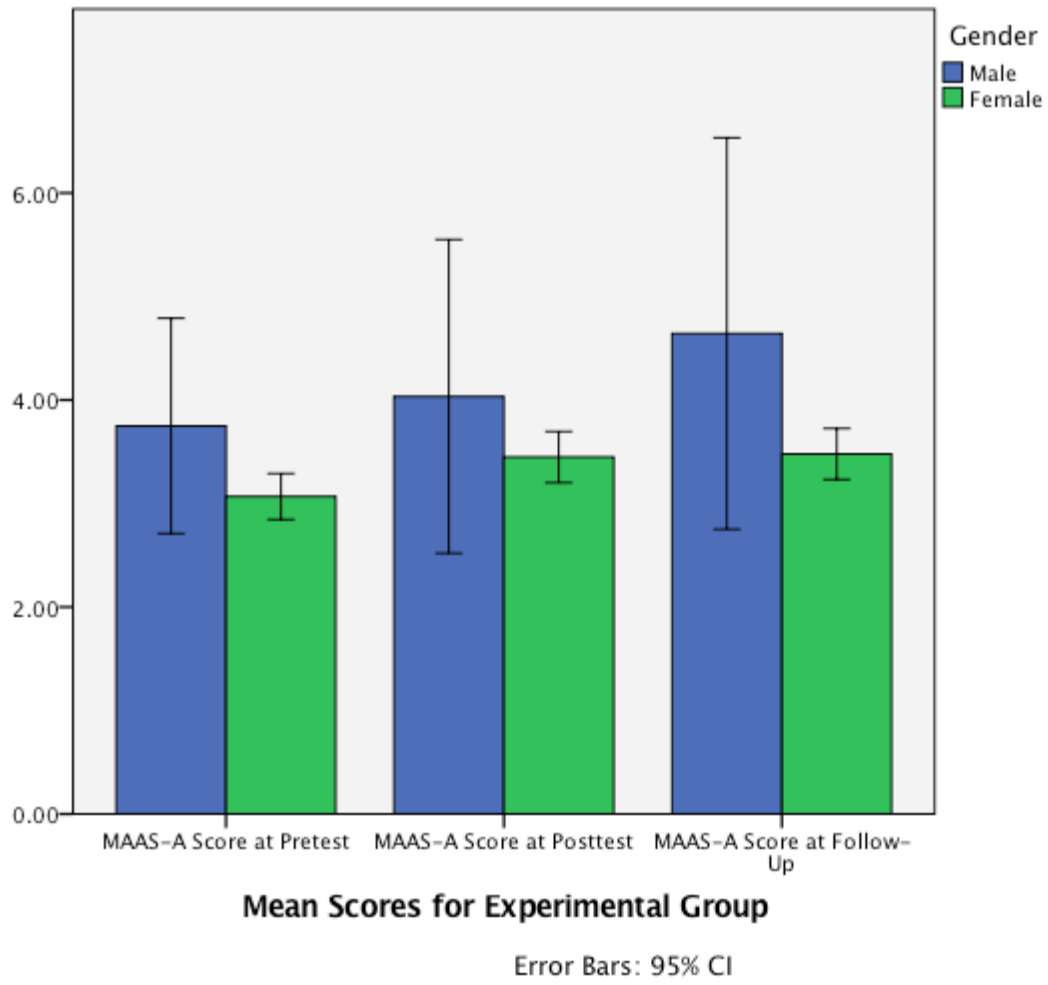

Figure 5. MAAS-A scores for experimental group between gender and across timepoints.

Note. MAAS-A = Mindful Attention Awareness Scale-Adolescent. Higher scores are indicative of more developed responding.

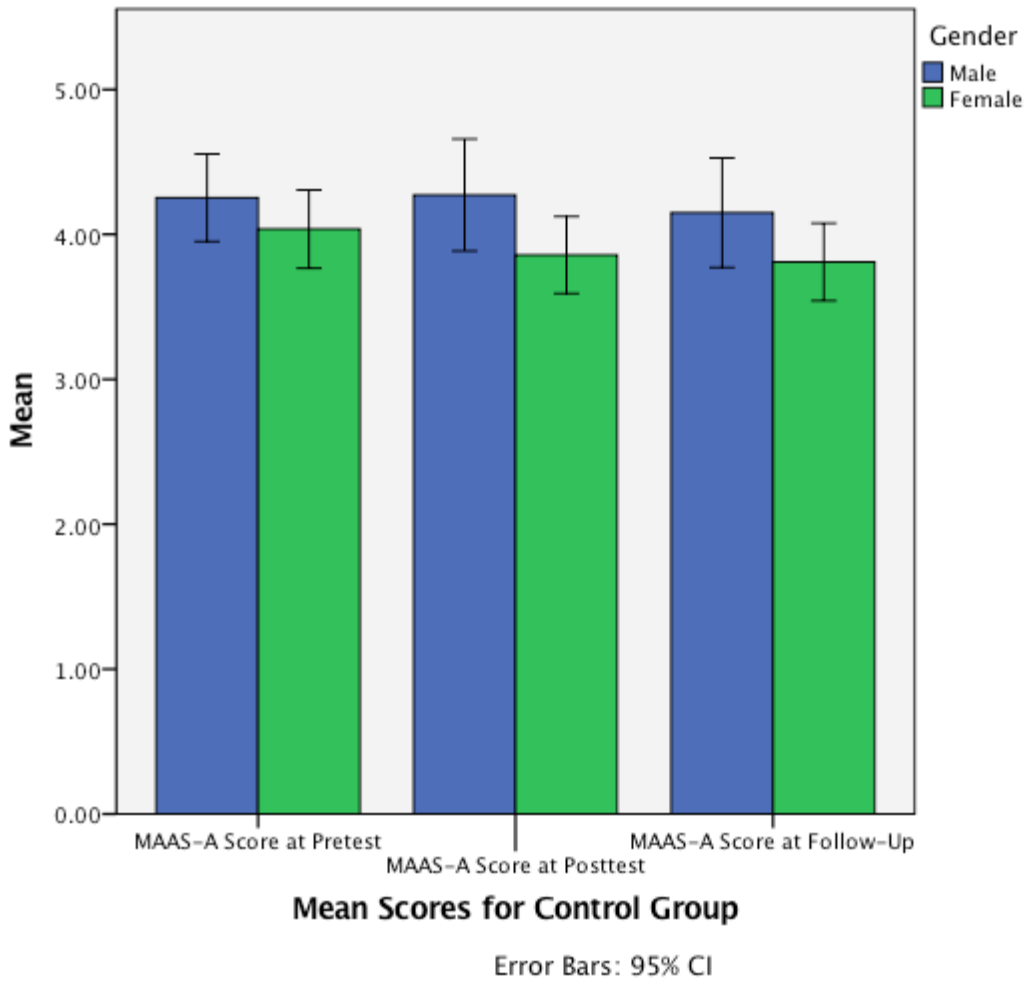

Figure 6. MAAS-A scores for control group between gender and across timepoints.

Note. MAAS-A = Mindful Attention Awareness Scale-Adolescent. Higher scores are indicative of more developed responding.

Table 5

MAAS-A Scores Between Gender and Across Conditions

Timepoint	Gender	Experimental Group MAAS- A Scores	Control Group MAAS- A Scores
T1			
		p = .69 (SD) .761	p = .28 (SD) .197
	Male	3.7	4.3
	Female	3.2	4.0
T2			
		p = .06 (SD) .347	p = .15 (SD) .850
	Male	4.0	4.3
	Female	3.4	3.9
T3			
		p < .05 (SD) .842	p = .27 (SD) .832
	Male	4.6	4.1
	Female	3.5	3.8

Note. MAAS-A = Mindful Attention Awareness Scale for Adolescents: T1 = pretest data collection; T2 = posttest data collection; T3 = follow-up data collection. p = probability value; *(SD)* = standard deviation

Hypothesis two. It was hypothesized that that students who participated in the mindfulness group would show a decrease in autonomic stress response, as measured by a pulse oximeter, relative to the physical education group, controlling for pre-test, at T2 through T3. Results indicated that participants in the mindfulness group had significant differences in pulse readings at T2 and T3, when compared to the physical education control. These results indicate that the mindfulness curriculum is correlated with a reduction in stress among the adolescent population. Thus, hypothesis two was supported.

According to Arnold et al. (2008), there is a considerable amount of research indicating that elevated pulse rates are strongly correlated with cardiovascular risk. The associations appear to be independent of other medical risk factors, as consistent correlations are seen among both healthy and unhealthy individuals. Although research is only in early stages, it is purported that increased heart rate may be a causal determinant of heart disease. Thirty-two studies, thus far, have demonstrated that increased pulse is an independent risk factor for early death. Arnold et al. (2008) reports that with an additional 20 beats per minute, premature mortality risk increases up to 50%. With students reporting an increase in stress (Smyth & Banks, 2012; Ysseldyke et al., 2004) and stress resulting in elevated pulse (Hasegawa et al., 2015), this is a serious concern that needs immediate attention.

Results from the current study indicated that 22.5% of the participants (*N*=9) in the mindfulness class had an initial pulse reading in the abnormal range. As mentioned early, a normal pulse falls within the rage of 50 to 90 beats per minute (Arnold et al., 2008). Each of these participants had pulse readings that fell within the normal range upon completion of the mindfulness intervention. In addition, 12.5% of the students (*N*=5) showed at least a 20 beat drop in heartrate from T1 to T2, while 37.5% (*N*=15) decreased their beats per minute by at least 10. Follow-up gains were sustained. These results show significant promise for stress reduction in the academic setting and potential illness prevention later in life.

The participants in the mindfulness group opted out of a regular physical education

class, which means that they were most likely engaging in less exercise compared to the students who participated in the physical education class. Future research would benefit from assessing whether participants were student athletes because the resting heartbeat of an athlete can fall below 40 beats per minute (Young, 2015). Without actual inquiry, it is impossible to know which students engaged in sports. If the assumption is correct, that less students in the mindfulness group participated in athletics, it makes these findings that much more impressive because reduction in pulse would be correlated solely with stress reduction and not additional cofounding variables, like exercise.

Unlike many similar studies, the current study did not make use of a self-report measure to assess stress. Use of self-report measures is common when evaluating levels of perceived stress; conversely, using a pulse oximeter as a measure of physiological stress is rare. A similar study conducted by Neary (2013) made use of a pulse oximeter to assess the effects of mindfulness in relation to stress. This study was a truncated version of the current study, and stress-related hypotheses were unfounded. It is possible that abbreviated mindfulness interventions are not positively correlated with stress reduction because it takes ample time to process and subsequently engage in mindfulness behavior. In fact, it has been suggested that initially some components of mindfulness (i.e. “observe" and "nonjudgment") may actually increase perceptions of stress (Araas, 2008).

Over time, with increased attention regulation and awareness of present moment experience, the reactivity of the wandering mind can be stymied; this process reduces emotional dysregulation. One study conducted by Prakash, Hussain, and Schirda (2015) confirms that when observing a variety of variables, the ability to regulate emotions was the only significant mediator of dispositional mindfulness and perceived stress. These findings illustrate the utility of emotional regulation as a latent mechanism contributing to the stress-reducing potential of dispositional mindfulness (Prakash et al., 2015). The reduction of stress

over longer periods of time as the potential to be of great value. Unfortunately, research assessing the effects of long-term mindfulness interventions is limited. More research is needed to corroborate these findings.

Hypothesis three. It was hypothesized that students who participated in the mindfulness group would improve their working memory skills, as measured by The Automated Operation Span Task (AOSPAN; Unsworth, Heitz, Schrock, & Engle, 2005), relative to the physical education group, controlling for pre-test, at T2 and T3. Initial results did not support this hypothesis, as there was no statistical difference between conditions at T2. A delayed treatment effect was seen at T3. These results indicate that after a 1-month time lapse, mindfulness is associated with improvement in working memory skills among the adolescent population. Thus, hypothesis three was partially supported.

Compared to other components of executive functioning, working memory is deemed more difficult to measure. Researchers allege that each observable task differs based on which brain structure is being stimulated. Therefore, "executive control" depends considerably on how much of the prefrontal cortex is being stimulated, which is nearly impossible to assess in a school setting (Best & Miller, 2010). Consequently, without access to advanced medical equipment, assessing working memory skills is potentially limited.

A reason for the delay in treatment effect may be, in part, due to initial significant differences in mindfulness, as measured by the MAAS-A. According to Brown and Ryan (2003) and Schooler et al., (2014), trait mindfulness correlates with working memory skills, indicating that more mindful individuals will typically perform significantly better on working memory tasks. Participants in the physical education class did, in fact, have significantly higher ($p < .01$) mindfulness scores at T1 ($M = 4.14$; $SD = .730$) vs ($M = 3.14$; $SD = .682$). Therefore, participants in the mindfulness group may have been at an initial disadvantage.

Preliminary significant differences in mindfulness is not the only possible explanation for the delayed treatment effect. Although the initial post-treatment results of

working memory skills were non-significant, noteworthy trends were seen in the data. For example, the physical education group had the highest working memory scores at T1 (M = 39.49; SD = 13.409) vs (M = 34.55; SD = 13.160). These differences were so stark that they approached a significant pretest difference (p = .077). In contrast, the physical education group had the lowest working memory scores at T3 (M = 41.75; SD = 16.811) vs (M = 42.79; SD = 11.870). The physical education class also showed marked variability from T1-T3. Conversely, the mindfulness education class saw a steady improvement of scores from T1 to T3 {(M = 34.55; SD = 13.160), (M = 41.60; SD = 13.735), (M = 42.79; SD = 11.870)}, resulting in a significant, but delayed treatment effect. It is difficult to conceptualize the actual improvement in working memory scores because, unlike typical IQ tests, the AOSPAN does not have a consistent standard deviation. The standard deviation fluctuates, sometimes greatly, with each administration. The standard deviation seen in this study varied from 11 to 16, which is consistent with similar studies (Quach et al., 2014). The mindfulness group showed a nine point improvement from T1-T3, while the physical education group demonstrated only a two point increase. The nine point improvement seen in the mindfulness group approaches the one standard deviation marker. A one standard deviation difference accounts for 68% of the data in the group, which signifies the likelihood that the improvement is most likely not due to chance (Fields, 2013). The two point increase for the physical education group does not come close to the standard deviation indicator, which means that it is more likely that the improvements were due to chance. Thus, although the mindfulness group did not reach the one standard deviation difference, trends reveal that with a more elongated treatment, it is possible that a more substantial difference will be exhibited both within the mindfulness group and between groups.

Data collection at T3 was taken right before finals and regents exams, which research notes is a stressful time (Smyth & Banks, 2012). It is likely that, unlike the physical education group, the mindfulness group utilized stress reduction techniques to cope with the added pressure of cumulative final exams. The ability of the students in the mindfulness class to stay present during a stressful time, may have

reduced mind-wandering during the attention task and resulted in higher scores.

In addition, memory consolidation may have played a role in the delayed results . There are fundamental limitations when considering consolidation of information in working memory (Vogel & Luck,2002). According to Bayliss, Bogdanovs, and Jarrold (2015), consolidation of information into working memory is a time-consuming and cognitively demanding process. Individual differences in memory consolidation are correlated with working memory performance in children. It is possible that these nuanced differences may have affected results. Bayliss et al. (2015) purports that memory traces become more sustainable and less vulnerable to interference with time. Providing opportunities for consolidation, like the elongated mindfulness curriculum seen in this study, does correlate with improvement in working memory performance. This is especially true for difficult tasks, like the AOSPAN. Thus, the notion of memory consolidation may explain why significant results were delayed.

The influence of sample size cannot be overemphasized. A smaller sample, like that which was used in this study, runs the risk that results may not have been adequately powered to detect a difference between groups (Nayak, 2010). As discussed previously, a large effect size was assumed, which only required 26 students in each condition for the power of the proposed study to be substantiated. This was expected because similar studies with a short-term intervention have demonstrated a medium effect size (Quach et al., 2014). Since research shows that individuals practicing mindfulness over time results in improved brain integration (Froeliger et al., 2012), it was assumed that a long-term intervention will result in a large effect size. This presumption was not substantiated and may have contributed to a lack of some significant findings.

Based on the trends in the data, it is possible that if a larger sample size was available, the between group differences may have been apparent sooner. To further exemplify the need for a larger sample size, it is important to note that other similarly designed studies (Quach et al., 2014), with larger sample sizes, have seen immediate post-test improvements. These studies have not maintained lasting significant effects, which solidifies the need to increase both treatment length, as was done in this study, and sample size.

Discussion of Secondary Hypotheses

Treatment moderators specify for whom or under what circumstances an intervention works and can subsequently dictate for whom interventions are most applicable (Sass, Berenbaum, & Abrams, 2013). This study looked at six different treatment moderators. Nayak (2010) warns that smaller samples, like this study, run the risk that results may not be sufficiently powered to detect an interaction effect. This may be the main reason why no interaction effects were seen in any of the hypotheses discussed below.

Hypothesis four. Previous research has demonstrated that individuals who are motivated by a personal commitment to the ongoing practice of meditation often show enhanced effects, such as, increased mindfulness and overall emotional well-being (Galla, Baelen, Duckworth, & Baime, 2016). Therefore, it was hypothesized that high levels of motivation would facilitate increased mindfulness skills. Hypothesis four predicted that students who were highly motivated to practice mindfulness meditation and who received the mindfulness curriculum would benefit the most from the intervention. As previously mentioned, motivation was calculated by taking the mean of the potential benefit and interest scores. There was no evidence for a significant interaction effect, indicating that motivation did not moderate the findings.

Due to the quasi-experimental nature of this study, students volunteered to participate

in the mindfulness class. Because participation was not mandated, there was an inherent interest in the experimental group. There was not the same level of interest seen in the control group. This fact can be quantified by a significant pre-test difference in level of interest between the two groups at the initiation of the intervention. Students in the mindfulness group were more interested and believed the class to be of more value; essentially, they were more motivated. Therefore, the homogeneity created little room for an interaction effect. Future researchers may benefit from utilizing a population that is not so eager to engage in mindfulness practice.

Hypothesis five. According to Fredrickson et al (2008), the broaden-and-build theory of positive emotions purports that an individual's daily experience with positive emotions builds over time to create a variety of personal resources, including mindfulness. Noteworthy to this study, Fredrickson et al (2008) found that when individuals engaged in meditation practice, over time they reported increased levels of mindfulness, indicating that meditation is an intervention strategy that produces elongated experience of positive emotions. Therefore, it was hypothesized that more previous experience would facilitate increased mindfulness skills. It was predicted that students who had the most previous experience with mindfulness meditation and who received the mindfulness curriculum would benefit the most from the intervention. Previous experience was gathered from a single question on the demographic questionnaire. There was no evidence for a significant interaction effect, indicating that previous experience did not moderate the findings.

Similarly, to the previous hypothesis, it is possible that the margin for interaction was simply too small. Students are only allowed to participate in the mindfulness class once during their four-year high school tenure. The more experienced meditators are more likely to be those students who have already completed the class, not the students that are just embarking on their mindfulness journey. Future research would benefit from obtaining a more diverse population, including both experienced and novice meditators.

Hypothesis six. A positive interaction between GPA and mindfulness skills was assumed because, when compared to their special education counterparts, regular education students typically have more difficulty comprehending abstract concepts, like mindfulness (Hott & Montani, 2014). Therefore, it was hypothesized that students who had the highest GPA and who received the mindfulness curriculum would benefit the most from the intervention. GPA was obtained from a self-report item on the demographic questionnaire. There was no evidence for a significant interaction effect, indicating that GPA did not moderate the findings.

The researcher did not have access to student report cards and, as a result, had to rely on self-reported GPA. As mentioned above, self-reports often result in issues with social desirability and may have potentially biased responding (Prince, et al., 2008). Additionally, the categories for GPA may have been defined too broadly. For example, a grade of "A" ranged from 90 to 100 and a grade of "B" ranged from 80 to 89. Approximately 97% of the sample reported a grade of either A or B and, as a result, there was not much latitude for interaction. Future researchers may therefore want to find a population where GPA is more variable.

Hypothesis seven. People who feel emotionally dysregulated are typically uncomfortable "feeling into" that tenuous emotional state, which is exactly what mindfulness practice advises. Previous research demonstrates a negative correlation between stress and the ability to be mindful (Sass et al., 2013). These results hold true for both physical and emotional stress. Research conducted by Trapp et al. (2014) showed that individuals struggled with mindfulness practice when they felt either emotionally or physically taxed and those individuals who were experiencing mental and physical stress concomitantly had the least proclivity towards mindfulness (Trapp et al., 2014). Therefore, it was hypothesized that students with the least amount of stress and who received the mindfulness curriculum would

benefit the most from the intervention. Stress was measured by pulse readings on a pulse oximeter. There was no evidence for a significant moderator effect, indicating that stress did not moderate the findings.

Participants in this study were taken from a community setting, which may have negatively influenced an interaction effect. Approximately 96% of the sample had a pulse reading in the average range and, as a result, there was not much space for a potential interaction. It is possible that if the sample was taken from a clinical setting, where participants exhibited higher levels of stress, the interaction would have been more profound. Future research would benefit from looking at students from a variety of settings with more diverse levels of stress.

Hypothesis eight. Research has shown that positive emotions transiently broaden an individual's attention, a main component of working memory. This momentary expansion of attention has a cumulative effect, gradually improving attention over time (Fredrickson et al., 2008). Through mindfulness, individuals learn how to attune to the present moment, which enhances the capacity for noticing fleeting moments of happiness, joy, and gratitude. Therefore, it was hypothesized that students who had the highest working memory scores and who received the mindfulness curriculum would benefit the most from the intervention. Working memory was measured by scores obtained from the computerized working memory task (AOSPAN). There was no evidence for a significant moderator effect, indicating working memory did not moderate the findings.

As mentioned prior, mindfulness is an abstract concept which can be difficult to fully comprehend, especially by high school students. Students participating in the mindfulness curriculum would have to possess adequate abstract reasoning skills and sufficient working memory skills as an unspoken prerequisite. Many individuals with learning disabilities struggle with these skills. The researcher did not have access to individual student's special education placements (IEPs) and was therefore unable to garner special education delineation. For the reasons mentioned above, it is likely that most of the students in the experimental group were not in special education and therefore, had no significant

difficulties with working memory. Soliciting students with IEPS may allow for a larger margin of interaction. Future research may want to include a more academically diverse population.

Hypothesis nine. Previous research has demonstrated that when participants have high levels of cortisol, which is a stress hormone, it negatively influences their working memory skills because there is a greater tendency towards mind-wandering and subsequent distractions. Specifically, mind-wandering interrupts the working memory's ability to pay attention and heightens the risk of distraction through rumination (Banks, Tartar, & Tamayo, 2015). Therefore, it was hypothesized that students who demonstrated the least amount of stress and who received the mindfulness curriculum would have the highest working memory scores. As previously noted, stress was measured by pulse readings from a pulse oximeter and working memory was measured by scores obtained from the computerized working memory task (AOSPAN). There was no evidence for a significant moderator effect, indicating stress did not moderate the findings. Only 4% of the sample had a pulse reading outside of the average range and as a result there was not much room for an interaction effect. It is possible that if the sample was taken from a clinical setting, where participants exhibited higher levels of stress, the interaction would be more profound.

Additional Analyses

Bootstrapping was used to examine multiple mediators in an attempt to rationalize the insignificant results of the MAAS-A. Mediation did not explain the findings, therefore, other factors must serve as an explanation. It is viable that the presence of mental health issues acted as an extraneous variable, possibly having an interaction effect with pre and post mindfulness scores. Future researchers may want to assume a positive interaction between mental health issues and mindfulness skills because, when compared to their typically developing peers, students with mental health concerns might be more invested in practicing mindfulness. Since mindfulness has become more mainstream and often boasts the promise of stress reduction, these students may be seeking out mindfulness to assuage mental

anguish. Because there was only one indication of a mental health issue, it was unable to be analyzed fully. Future researchers would benefit from testing these items (mindfulness and mental health status) together as moderators.

Mental health was assessed by a single-item question that asked students, “Do you have any emotional problems for which you need help?” This question was followed by another that asked, “Are you currently under supervision of a mental health professional?” There is still a lot of stigma around mental health so it is possible that individuals did not admit to having an issue. They may also have been fearful that the help of a mental health professional would have been mandated if they had answered yes to the initial question regarding mental health status.

The stigma surrounding mental health issues stops many adolescents from getting the help that they need (Angermeyer & Matschinger, 2003). According to the National Alliance on Mental Health (NAMI, 2017), one in five students will be diagnosed with a mental health disorder between high school and middle school. These staggering figures do not include the subclinical cases, which may dramatically raise the already high statistics. Because, on average, 20% of students suffer from a mental health disorder, it is highly likely that students did in fact have mental health problems, but did not admit to them. It is possible that students with mental health disturbances were drawn to the mindfulness class because it provided a safe place to talk about sensitive topics and learn stress reduction techniques while receiving social support.

The National Alliance on Mental Health (NAMI, 2017) asserts that social support is a critical factor in stress management. A social support network is not the same as group therapy. Unlike the typical group therapy format, a social support system is much more readily available and issues are not pathologized. The community, which is formed during a long-term mindfulness intervention, can be viewed as an intersect between a social support

system and group therapy. The role of a mindfulness instructor is in no way synonymous with a mental health clinician, yet the semi-structured classes lend themselves to a group therapy environment. Heightened feelings of worthiness and security, as well as a sense of belonging, are common results of an MBSR style intervention. It is entirely possible that the positive effects of group cohesion may have subsequently contributed to the stress reduction seen in this study. Future studies would benefit from taking this extraneous variable into account.

Adolescents struggling with mental health issues have a much harder time with self-regulation than their typically developing peers. This failure to self-regulate may occur due to excessive demands being placed on the brain without sufficient neural integration or the facility to manage them (Siegel, 2013). Even for students not struggling with mental health issues, high school can be a very stressful time. Often students feel overtaxed and do not have a healthy outlet to discharge this toxic stress. Students participating in the mindfulness class may have had the opportunity to recharge and reset, releasing stress and helping to create a healthier body and mind.

Stress may have been released by the deep breathing techniques taught in the curriculum. Deep breathing, also known as Pranayamic breathing, is a component of the mindfulness curriculum, however, it is also a common practice in a variety of other modalities, like yoga. “Pranayamic breathing, defined as a manipulation of breath movement, has been shown to contribute to a physiologic response characterized by the presence of decreased oxygen consumption, decreased heart rate, and decreased blood pressure, as well as increased theta wave amplitude in EEG recordings, increased parasympathetic activity accompanied by the experience of alertness and reinvigoration.” (Jerath, Edry, Barnes, & Jerath, 2006, p. 566). Deep breathing is a powerful stress reduction activity. When students engage in deep breathing, it alerts the nervous system to calm down and

activates the "rest and digest response." The body responds to the messages from the brain with reduced blood pressure and heart rate (Jerath et al., 2006), which was seen in the current study.

There is an abundance of research that focuses on the harmful effects of psychological stress on working memory. Researchers suggest that cortisol increases the tendency to mind wander, which negatively influences working memory capacity (Banks et al., 2015). A study conducted by Flores and Berenbaum (2017), found that perceived social support protects against psychological distress and can facilitate the removal of extraneous interference which subsequently improves working memory. It is possible that the supportive relationships fostered by the long-term mindfulness intervention resulted in decreased stress and concurrent working memory enhancement.

Clinical Implications

The findings from this study add to the growing research that documents the impressive gains seen after implementation of a school-based mindfulness program. Mindfulness-based school interventions have seen success despite considerable differences in ethnic make-up (Bakosh, 2013), special needs designation (Yosai, 2017), socioeconomic status (Quach, 2014), and a variety of other demographic variables, without any notable negative effects (Bakosh, 2013). Mindfulness interventions can be relatively non-intrusive when executed school-wide, as documented in a study by Bakosh (2013), that asked elementary school students to listen to 90 guided meditations for 10 minutes each day for a total of 10 weeks. More than 97% of the teachers interviewed reported an affinity for the intervention and had no issues with implementation. Truncated interventions, like the one described above, do not offer a panacea to alleviate all problems. Issues arise when these types of programs are not well-maintained; research indicates that with the passage of time most advances are proportionately lost (Durlak, Weisserbg, Dymnicki, Taylor, & Schellinger, 2011). To maintain the rigor of daily practice, it is necessary for schools to allocate time each day to practice mindfulness; a school-wide intervention is ideal.

At a community level, long-term mindfulness programs have the capacity to encourage school-connectedness through improving relationships with both peers and

teachers. Mindfulness interventions have shown an enrichment in interpersonal relationships and an enhancement in emotion regulation, for both students and teachers alike (Spowart, 2014). In addition, mindfulness interventions have seen a decrease in teacher burnout, improvement in class management and empathy (Brunsting, Sreckovic, & Lane, 2014). Teacher reengagement leads to improvement in teacher productivity, a greater sense of overall school-cohesion, increased student compliance, heightened scholastic success and healthy brain development (Singh, Lancioni, Winton, Karazsia, & Singh 2013), especially with respect to working memory.

There has been a recent surge of research and special attention paid to the effects of high stakes testing on learning outcomes, as well as consequences for teachers. Research reveals a sense of anxiety and decrease in school connectedness, especially with older students (Smyth & Banks, 2012). Students, of all ages, actively report being overwhelmed by stress (Ysseldyke et al., 2004). Schools must make room in their curriculum to provide ways for students to deal with this stress and mindfulness interventions may be the answer. Initiating a mindfulness-based intervention prior to engagement in high stakes testing may assist with school-cohesion by decreasing stress for both students and school personnel.

All too often though, school personnel are looking for a "quick fix" and mindfulness is just the opposite. It is inconceivable to liken the practice of mindfulness as an 'add-on,' or for mindfulness instruction to be labeled as "a set of techniques, a collection of skills which can be learned" (Crane et al., 2012, p. 79). Instead, it is a "way of being" which develops through persistent engagement with the practice and eventually becomes internalized by the individual. With the exponential increase in mindfulness-based interventions and the fast-paced nature of our society, it is easy to get caught up in the mindfulness hype without surrendering into the full experience. Crane et al. (2012) warns that the sudden deluge of interest in the implementation of mindfulness-based interventions in a variety of contemporary settings, like schools, holds both promise and peril.

It is encouraging that, thus far, mindfulness interventions have shown significant improvements in a variety of academic domains as well as in stress reduction. Research indicates that engaging in mindfulness practice can train the brain in a way that enables an increased capacity for learning (Alloway, 2009). Therefore, it makes sense that, after a mindfulness intervention, students saw improvement in the areas of reading comprehension, language comprehension, listening comprehension, problem solving, and complex reasoning (Yosai, 2017). The threat is that the integrity of the practice may be lost somewhere along the way.

This is not a predicament that can be solved overnight. Regardless, to successfully implement a long-term mindfulness program, it is imperative to have district-wide buy in. It is not practical to assume that all districts will be as willing to implement a long-term intervention. Many people still view mindfulness as a fringe practice. Western society, in general, is less accepting of the mind-body approach to wellness. Current trends show, as research continues to demonstrate impressive benefits, more schools are becoming interested. As discussed above, it is vital to have an experienced practitioner on staff to demystify the stigma around mindfulness practice.

Strengths

The current study demonstrates numerous strengths, including having an experienced practitioner on staff. The mindfulness curriculum was piloted the year prior to the intervention, with encouraging qualitative results. Any ‘hiccups’ that may have surfaced had an entire year to be ameliorated before intervention initiation. Also, students were kept in their original classes, keeping scheduling and routine relatively unchanged. The teacher in charge of implementing the curriculum is a qualified mindfulness teacher, having received extensive education directly under the supervision of Jon Kabat-Zinn. Research shows that the amount of mindfulness training is positively correlated with treatment outcomes (Van

Aalderen, Breukers, Reuzel, & Specken, 2012). Additionally, the literature on teacher effectiveness constantly stresses the importance of the teacher having an ongoing experiential engagement with mindfulness practice and keeping up-to-date with the most current research. The mindfulness teacher employed in this study has a very dedicated daily mindfulness practice and teaches a variety of mindfulness classes throughout the school year, in addition she attends many silent retreats and conferences on the subject of mindfulness. It was her vision to see the positive effects of mindfulness through an elongated curriculum.

Longitudinal research is of paramount importance because it establishes the validity of maintenance and long-term gains (Norrish & Vella-Brodrick, 2009). Similar studies, which have seen immediate post-test improvements, have not maintained lasting significant effects (Quach et al., 2014). As discussed above, the adolescent brain is transforming considerably, and this plasticity helps make it more receptive to intervention. A longer intervention allows for even more enhancement, which is vital because the brain changes in adolescence can have direct influence on adult development at social, behavioral, and physiological levels (i.e. stress response).

In a variety of similar studies (Quach et al., 2014; Yosai, 2017), stress was gauged by a self-report measure. Due to the sensitive nature of perceived stress and issues with self-report reliability, this study employed a more objective measure (i.e. pulse oximeter) under the supervision of a licensed nurse. The use of a pulse oximeter in a long-term mindfulness intervention is non-existent. Objective measures help to strengthen the validity of findings (Prince et al., 2008) and is therefore a strength of the current study. Like the use of self-report measures, the use of self-reported fidelity checklists can be similarly biased. To counter any potential biases, a fidelity checklist was utilized by the researcher, two outside integrity evaluators and the mindfulness instructor responsible for teaching the experimental group, equating to four individuals in total. As previously mentioned, self-reports cannot entertain all personality variables like honesty or image management, which can greatly

effect responding. Issues with introspection and social desirability biases are also common problems observed in self-reporting.

An additional strength of this study was the use of a supplemental measure. The use of multiple, objective tools helped to get a more comprehensive assessment of student behavior. A behavior probe was utilized as an observational tool based on teacher perception. Teachers reported if improvements in working memory skills translated into students paying better attention in the classroom setting. This type of assessment is deemed an advancement over self-report measures because of its capacity to translate potential differences between what someone says and their actual behavior (Mays & Pope, 1995). Direct observation is one of the most common measurement tools used in the school setting. It is considered one of the most direct and unbiased assessment tools available for evaluating an adolescent's academic behavior (Briesch, Chafouleas, & Riley-Tillman, 2010; Volpe, DiPerna, Hintze, & Shapiro, 2005).

Three teachers completed a paper and pencil single-item response and the mean of their scores was used to quantify observable working memory skills for each individual participant. Previous research has shown that single item measures have equally high predictive validity as multiple-item measures (Bergkvist & Rossiter, 2007). Three teachers were used for each individual student to reduce the risk of conservative, exaggerated, or reactionary responses. In addition, approximately 50 teachers completed the single-item response to reduce potential expectation biases. Although teachers were not told which students were in the experimental group, it is possible that some teachers were aware and held preconceived expectations that influenced their responses.

Previous research has demonstrated that multiple people with consistent inter-rater reliability is ideal (Fallon, Kurtz, Mueller, 2017; Altman, 1991). There was moderate agreement seen between the teachers in this study. Because the three teachers were observing

the students in three different classrooms, inter-rater reliability was not expected to be perfect. To reduce the risk of confusion or subjectivity, working memory was operationally defined and visually displayed each time the paper was distributed to the teachers.

To reduce the risk of preconceived expectations influencing response style, blinding can be used. Blinding is important, especially when it is feasible that the outcome can be affected by the investigator's expectations, like in this study (Misra, 2012). There are three possible types of blinding. A single blind study is when the participant is unaware which treatment he or she is receiving. Double blind is when both the participant and the investigator, in this instance the teacher, are blinded. Triple blind, which is ideal, is when the participant, investigator and data collectors are blinded. Although, the statistician must know which participants are in the same group, so he or she can only be partially blinded (Misra, 2012). In the current study, it was inconceivable to use blinding for the students because the classes were volunteer based. Also, the teachers were only able to be partially blinded. The physical education teachers of the students in the physical education control group and the mindfulness teacher of the students participating in the mindfulness class were obviously privy to which group their students were assigned. Most of the teachers were not informed which students were in which group, but it is likely that some teachers were friends and subsequently discussed the study amongst themselves, especially since the study garnered much excitement for some.

Previous research has demonstrated that multiple people with consistent inter-rater reliability is ideal (Fallon, Kurtz, Mueller, 2017; Altman, 1991). There was moderate agreement seen between the teachers in this study. Because the three teachers were observing the students in three different classrooms, inter-rater reliability was not expected to be perfect. To reduce the risk of confusion or subjectivity, working memory was operationally defined and visually displayed each time the paper was distributed to the teachers.

Limitations

The lack of blinding may have been an issue at the participant level. It is possible that as a reactionary response, the participants in the control group put more effort in to being

mindful because they knew that they were being compared to a group receiving mindfulness training. This is unlikely however, because compared to the mindfulness group, the physical education group was rowdier during data collection, with the need for redirection on multiple occasions.

Blinding may have been an issue at the teacher level as well. It was obvious, by her enthusiasm for the material, that the mindfulness teacher was highly motivated. Shadish, Cook, and Campbell (2002) warns that the lack of equitable vested interest may influence the experiment. Future researchers may want to consider using the same teacher for both the control and experimental group.

Although the study employed a variety of objective measures, especially in relation to testing working memory skills, this study did not include the Automated Working Memory Assessment (AMWA; Alloway, 2007), which is given to school-aged children to screen for deficits in working memory. This additional measure may have assisted with standardizing reliability between groups (Yosai, 2017). Future researchers would be well advised to add this assessment to their testing battery. Additionally, previous research has found greater gains for individuals who complete homework as part of an intervention (Kazantzis, Deane, & Ronan, 2000). As mentioned previously, mindfulness skills are augmented with practice. It is plausible that improvement in working memory skills may have demonstrated a significant difference sooner if homework assignments were mandated as part of the mindfulness curriculum. This limitation can be easily addressed in future research.

The addition of qualitative data may have made for a more comprehensive study. Prior to the initiation of the study, participants were asked if they thought that they would benefit from a program that taught them how to become more mindful. The students were not asked a similar question at follow-up. It would have made the study more robust to see if students believed that they had benefited from the intervention and whether they planned to continue to practice mindfulness beyond the intervention.

Compared to other studies (Bakosh, 2013; Quach 2014; Yosai, 2017) the participant pool was restricted in socioeconomic status and demographic diversity, with most of the students being Caucasian and from affluent families. Due to homogeneity, variability in socioeconomic status and ethnicity could not be assessed. It is uncertain whether results would have varied with a more diverse group of students. Additionally, most of the participants in the mindfulness group were female (90%), whereas only half (52%) of physical education participants were female. As mentioned above, females typically score slightly lower on measures assessing dispositional mindfulness and dispositional mindfulness has been shown to have a positive correlation with working memory skills. Therefore, results may have been negatively skewed.

Participation in extracurricular activity was also not addressed. According to Rossmaur (2016), learning to play a musical instrument has the potential to stimulate areas of the brain unreachable by other means. Consequently, music has been said to augment brain development and improve working memory skills. It is uncertain whether students who played musical instruments scored differently than their nonmusically inclined peers. Future researchers may want to include participation in intramural activities, with special attention given to musical endeavors.

The experimenter did not have access to attendance and therefore, was unable to assess if attendance was a cofounding variable. Future research may benefit from collecting attendance information. In addition, data were only collected from one public high school in a suburb on Long Island. Therefore, results may not generalize to adolescents in different regions or participating in alternative schooling (home schooling, private, charter schools). It is possible that gifted students may have responded differently to the intervention. To address this limitation and others, it is suggested that future research include a variety of

scholastic settings and consider a more variable demographic than the one utilized in this study.

School administrators were extremely accommodating and instrumental in insuring completion of the current study. They were heavily involved with the study and had only a few strict guidelines for the researcher. The principal made it abundantly clear that academics were of primary importance. It was not possible to assess students at a variety of timepoints because the principal feared it would take away from class time. The principal agreed to pulling students out only for T1-T3 assessments; additional pullouts were not permissible. It would behoove future researchers to use a multiple timepoint design for further studies. This would help researchers to observe trends and gage if significant differences were seen prior to study completion.

According to Shadish et al. (2002), quasi-experiments test hypotheses with variables that can be actively manipulated to attain a desired outcome. Unlike randomized experiments, quasi-experiments do not employ random assignment. When completed accurately, a randomized experiment will have two groups displaying equivalency, in all ways except for the treatment. Consequently, the differences that occur can be causally linked to the variable being studied (Slavin, 2002). Alternatively, in quasi-experimental designs, group assignment occurs nonrandomly. For example, in this study students volunteered to sign up for either the mindfulness class or the physical education class. Due to the school setting, it was not plausible or feasible to utilize random assignment. The inability to draw causal inferences was a definitive weakness of this study. Future studies may benefit from looking at whether volunteering versus obligatory participation would result in a different outcome.

Future Research

The necessity of sufficient working memory skills is of principle importance in an

academic setting, as the underdevelopment of these skills has a detrimental effect on all relevant measures of scholastic performance (Holmes & Gathercole, 2013). Impairment in working memory skills is correlated with academic underachievement in all subject areas and according to Holmes and Gathercole (2013), a sizeable majority of students with low working memory skills are unable to sustain the minimum standards in reading and math. This reality is especially deleterious for students placed in special education, who are six times more likely to have working memory deficits than their regular education peers. Hence, these students are ideal candidates for a mindfulness intervention.

Previous research has shown improvements in working memory skills for individuals classified by the committee on special education (Bakosh, 2013), as well as those students with subclinical impairments, like ADHD (Cameron, 2017). Therefore, identifying students at risk and looking at students with individualized education programs (IEPs), as separate variables, may help researchers acquire more knowledge and discern who has the greatest gains. In addition, it may also be beneficial for future studies to investigate the relationship between mindfulness and a variety of academic measures (i.e. standardized testing, GPA, etc.). Looking at post-test measures of overall GPA may help to determine the cumulative effect of a long-term mindfulness practice on quantifiable cognitive outcomes (Bakosh, 2013).

As discussed above, the academic achievement and scholastic gains obtained from a long-term mindfulness intervention program has the potential be substantial, both individually and system wide. The reduction on the financial burden as well as the positive impact on social-emotional well-being makes future exploration of paramount importance. It should be a priority for future researchers to conduct follow-up studies with a larger, more diverse sample. Additionally, utilizing a true experimental design will help to determine if these gains are generalizable. Only then can researchers accurately assess the genuine value of a long-term mindfulness intervention.

Conclusion

The current study sought to investigate the effectiveness of a long-term mindfulness

curriculum by examining the effects of the intervention on working memory skills, stress and the ability to be mindful. While prior studies have found significant relationships between mindfulness and a variety of variables, they lack the sustainability exhibited by this study. Several of the findings from the current study are encouraging; however, researchers are only just beginning to operationally define and assess the complex and somewhat abstract construct of mindfulness. Research on this topic has gained considerable momentum, but is still in its nascent stages. Therefore, it is critical that interest remained piqued so researchers can learn more about the potential effects that mindfulness has on adolescent behavior and subsequent academic functioning.

References

Abdo, N. (2012). Academic performance and social/emotional competence in adolescence. *Dissertation Abstracts International, 73,* 1289.

Adolfsdottir S., Sorensen L., & Lundervold A. J. (2008). The attention network test: A characteristic pattern of deficits in children with ADHD. *Behavioral and Brain Functions,* 4-9.

Alexander, C. M., Teller, L. E., & Gross, J. B. (1989). Principles of Pulse Oximetry: Theoretical and Practical Considerations. *Anesthesia & Analgesia, 68*(3), 368-376.

Alloway, T. P. (2009). The cognitive and behavioral characteristics of children with low working memory. *Child Development, 80*(2)*,* 606-621.

Alloway, T. P. (2009). Working memory, but not IQ, predicts subsequent learning in children with learning difficulties. *European Journal of Psychological Assessment, 25*(2), 1-7.

Altman, D.G. (1991). *Practical Statistics for Medical Research.* Chapman and Hall, London.

Anderson, G. (2001). *Pragmatic Markers and Social Linguistic Variation*. Amsterdam, Netherlands: John Benjamins Publishing Company.

Angermeyer, M. C., & Matschinger, H. (2003). The stigma of mental illness: effects of labelling on public attitudes towards people with mental disorder, *Acta Psychiatrica Scandinavica 108*(4), 304-309.

Araas, T. E. (2008). *Associations of mindfulness, perceived stress, and health behaviors in college freshmen* (Order No. 3303258).

Arnold, J. M., Fitchett, D. H., Howlett, J. G., Lonn, E. M., & Tardif, J.-C. (2008). Resting heart rate: A modifiable prognostic indicator of cardiovascular risk and outcomes? *The Canadian Journal of Cardiology*, *24*(Suppl A), 3A–8A.

Baddeley, A. (1992). Working Memory. *Science, 255*, 556-559.

Bakosh, L. S. (2013) *Investigating the Effects of a Daily Audio-Guided Mindfulness Intervention for Elementary School.*

Banks, J. B., Tartar, J. L., & Tamayo, B. A. (2015). Examining factors involved in stress-related working memory impairments: Independent of conditional effects? *Emotion, 15*(6), 827-836.

Bayliss D.M., Bogdanovs J., Jarrold, C. (2015) Consolidating working memory: Distinguishing the effects of consolidation, rehearsal and attentional refreshing in a working memory span task. *J Mem Lang* 81, 34-50.

Bergkvist, L., & Rossiter, J. R. (2007). The predictive validity of multiple-item versus single- item measures of the same constructs. *Journal of Marketing Research, 4,* 175-184.

Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development, 81*(6), 1641-1660.

Biegel, G. M., Brown, K. W., Shapiro, S. L., & Schubert, C. M. (2009). Mindfulness-based stress reduction for the treatment of adolescent psychiatric outpatients: A randomized clinical trial. *Journal of Consulting and Clinical Psychology*, *77*, 855-866.

Biegel, G. M., Chang, K., Garrett, A., & Edwards, M. (2014). Mindfulness-based stress reduction for teens. In R. A. Baer, R. A. Baer (Eds.), *Mindfulness-based treatment approaches: Clinician's guide to evidence base and applications (2nd ed.)* (pp. 189-212). San Diego, CA, US: Elsevier Academic Press.

Briesch, A. M., Chafouleas, S. M., Riley-Tillman, T. C. (2010). Generalizability and dependendability of behavior assessment methods to estimate academic engagement: A comparison of systematic direct observation and direct behavior rating. *School Psychology Review, 39*(3), 408-421.

Broderick, P. C. (2013). *Learning to breathe: A mindfulness curriculum for Adolescents to Cultivate Emotion Regulation, Attention, and Performance.* Oakland, CA: New

Harbinger Publications.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822-848.

Brown, K. W., West, A. M., Loverich, T. M., & Biegel, G. M. (2011). Assessing adolescent mindfulness: Validation of an adapted Mindful Attention Awareness Sale in adolescent normative and psychiatric populations. *Psychological Assessment, 23,* 1023-1033.

Brown, Z., Edworthy, J., Sneyd, J. R., & Schlesinger, J. (2015). A comparison of linear and logarithmic auditory tones in pulse oximeters. *Applied Ergonomics*, *51,* 350-357.

Brunsting, N. C., Sreckovic, M. A., & Lane, K. L. (2014). Special education teacher burnout: A synthesis of research from 1979 to 2013. *Education & Treatment of Children, 37*, 681-712.

Cameron, K. L. (2017). *Effect of a mindfulness intervention on early primary school children with subclinical ADHD* (Order No. 10284922).

Centers for Disease Control and Prevention. (2015). Mental Health. Retrieved from: https://www.cdc.gov/mentalhealth/

Champagne, C., McNairn, H., Daneshfar, B. & Shang, J. (2014). A bootstrap method for assessing classification accuracy and confidence for agricultural land use mapping in Canada, *Science Direct, 29,* 44-52.

Ciccone, N. (2016). Learning mindfulness at Lynbrook High School: A teacher pioneers a new wellness curriculum. *LI Herald*, 1-3. Retrieved from: http://liherald.com/lynbrook/stories/Lynbrook-teacher-pioneers-meditation-curriculum,78169?page=1&

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159.

Cook, E., & Dunifon, R. (2012). Do family meals really make a difference? Retrieved from http://www.human.cornell.edu/pam/outreach/upload/Family-Mealtimes-2.pdf

Crane, R. S., Kuyken, W., Williams, J. M. G., Hastings, R. P., Cooper, L., & Fennell, M. J. V. (2012). Competence in Teaching Mindfulness-Based Courses: Concepts, Development and Assessment. *Mindfulness*, *3*(1), 76–84.

Cullen, M. (2011). Mindfulness-based interventions: An emerging phenomenon. *Mindfulness Journal, 2*(3), 186-193.

Dale, L. P., Mattison, A. M., Greening, K., Galen, G., Neace, W. P., & Matacin, M. L. (2009). Yoga workshop impacts psychological functioning and mood of women with self-reported history of eating disorders. *Eating Disorders: The Journal Of Treatment & Prevention*, *17*(5), 422-434.

de Bruin, E. I., Zijlstra, B. J. H., van de Weijer-Bergsma, E., Bögels, S. M. (2011). The Mindful Attention Awareness Scale for Adolescents (MAAS-A): Psychometric properties in a Dutch sample. *Mindfulness Journal, 2*(3), 201–211.

Duncan, L. G., & Bardacke, N. (2010). Mindfulness-based childbirth and parenting education: Promoting family mindfulness during the perinatal period. *Journal of Child and Family Studies, 19*(2), 190-202.

Durlak, J. A., Weisserbg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact on enhancing student's social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development, (82)*1, 405-432.

Fallon, L. M., Kurtz, K. D., & Mueller, M. R. (2017). Direct Training to Improve Educators' Treatment Integrity: A systematic review of single-case design studies. *School Psychology Quarterly.* Advance Online Publication.

Fan, J., McCandliss, B. D., Sommer, T., Raz, M., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive*

Neuroscience, 14(3), 340-347.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). Thousand Oaks, CA: Sage.

Flook, L., Goldberg, S. B., Pinger, L., & Davidson, R. J. (2015). Promoting prosocial behavior and self-regulatory skills in preschool children through a mindfulness-based kindness curriculum. *Developmental Psychology, 51*(1), 44-51.

Flores, L., Berenbaum, H. (2017). The social regulation of emotion and updating negative contents of working memory, *Emotion, 17*(4), 577-588.

Fredrickson, B. L., Cohn, M. A., Coffey, K. A., Pek, J., & Finkel, S. M. (2008). Open hearts build lives: Positive emotions, induced through loving-kindness meditation, build consequential personal resources. *Journal Of Personality And Social Psychology*, *95*(5), 1045-1062.

Froeliger, B., Garland, E. L., Kozink, R. V., Modline, L. A., Chen, N., McClernon, F. J., … Sobin, P. (2012). Meditation-State Functional Connectivity (msFC): Strengthening of the dorsal attention network and beyond. *Evidence-Based Complementary and Alternative Medicine,* 1-9.

Froh, J. J., Bono, G., & Emmons, R. A. (2010). Being Grateful is beyond good manners: Gratitude and motivation to contribute to society among early adolescents. *Motivation & Emotions, 34*, 144-157.

Furnham, A, (1986). Response bias, social desirability, and dissimulation. *Personality and Individual Differences, 7*(3), 385-400.

Galla, B. M., Baelen, R. N., Duckworth, A. L., & Baime, M. J. (2016). Mindfuness, meet self regulation: Booting out-of-class meditation practice with brief action plans. *Motivation Science, 2*(4), 220-237.

Goodman, T. A. (2005). Working with Children: Beginners Mind. In C. K. Germer, R. D.

Siegel, P. R. Fulton, C. K. Germer, R. D. Siegel, P. R. Fulton (Eds.), *Mindfulness and psychotherapy* (pp. 197-219). New York, NY, US: Guilford Press.

Gradisar, M., Terrill, G., Johnston, A., & Douglas, P. (2008). Adolescent sleep and working memory performance. *Sleep and Biological Rhythms, 6*, 146-154.

Grossman, P. (2011). Defining mindfulness by how poorly I think I pay attention during everyday awareness and other intractable problems for psychology's (re)invention of mindfulness: comment on Brown et al. (2011). *Psychological Assessment, (23)*4, 1034-1040.

Gunaratana, B. H. (2011). *Mindfulness in plain English.* Somerville, MA: Wisdom Publication.

Hasegawa, M., Hayano, A., Kawaguchi, A., & Yamanaka R. (2015). Assessment of autonomic nervous system function in nursing students using an autonomic reflex orthostatic test by heart rate spectral analysis. *Biomedical Reports, 3*(6), 831-834.

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 78*(2), 169-183.

Holmes J., & Gathercole S. E. (2013). Taking working memory training from the laboratory into schools. *Educational Psychology, 34,* 440-450.

Hott, B. L. & Montani, T. (2014). Strategies and interventions to support students with mathematics disabilities. *Council For Learning Disabilities,* 1-9. Obtained from: www.cldinternational.org

Iyriboz, Y., Powers, S., Morrow, J., Ayers, D., & Landry, G. (1991), Accuracy of pulse oximeters in estimating heart rate at rest and during exercise. British Journal of Sports Medicine, 3, 162-164.

Jao, T., Li, C. W., Vertes, P.E., Wu, C. W., Achard, S., Hsieh, C. H., … Bullmore, E. T.

(2016). Large-Scale Functional Brain Network Reorganization During Taoist Meditation. *Brain Connect, 1,* 9-24.

Jerath, R., Edry, J. W., Barnes, V. A., & Jerath, V. (2006). Physiology of long pranayamic breathing: Neural respiratory elements may provide a mechanism that explains how slow deep breathing shifts the autonomic nervous system, *Science Direct (67)*3, 566-571

Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness*. New York: Delacorte Press.

Kabat-Zinn, J. (2003). Mindfulness based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice, 10*(2), 144-154.

Kaufman, S. B., DeYoung, C. G., Gray, J. R., Brown, J., & Mackintosh, N. (2009). Associative learning predicts intelligence above and beyond working memory and processing speed. *Intelligence, 37*, 374-382.

Kazantzis, N., Deane, F. P., & Ronan, K. R. (2000). Homework assignments in cognitive and behavioral therapy: A meta-analysis. *Clinical Psychology: Science and Practice, 7*, 189-202.

Kilpatrick, L. A., Suyenobu, B. Y., Smith, S. R., Bueller, J. A., Goodman, T., Creswell, J. D., … Naliboff, B. D. (2011). Impact of Mindfulness-Based Stress Reduction Training on Intrinsic Brain Connectivity. *NeuroImage*, *56*(1), 290–298.

Kim, H. Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution using skewness and kurtosis. *Restorative Dentistry & Endodontics*, *38*(1), 52–54.

Kingsland, J. (2016). *Could meditation really help slow the ageing process?* Retrieved from: https://www.theguardian.com/science/blog/2016/mar/03/could-meditation-really-help-slow-the-ageing-process

La Torre, M. A. (2001). Meditation and psychotherapy: An effective combination. *Perspectives In Psychiatric Care*, *37*(3), 103-106.

Leahy, C., Radhakrishnan, H., & Srinivasan, V. J. (2013). Volumetric imaging and quantification of cytoarchitecture and myeloarchitecture with intrinsic scattering contrast. *Biomedical Optics Express*, *4*(10), 1978–1990.

Levinson, D. B., Stoll, E. L., Kindy, S. D., Merry, H. L., & Davidson, R. J. (2014). A mind you can count on: validating breath counting as a behavioral measure of mindfulness. *Frontiers in Psychology, (5)*1202, 1-10.

Luciana, M. (2013). Adolescent brain development in normality and psychopathology. *Development And Psychopathology*, *25*(4, Pt 2), 1325-1345.

Lutz, A., Jha, A. P., Dunne, J. D., & Saron, C. D. (2015). Investigating the phenomenological matrix of mindfulness-related practices from a neurocognitive perspective. *American Psychologist*, *70*(7), 632-658.

Mandossian, A. (2017). Why multitasking destroys your productivity. Retrieved from https://www.earlytorise.com/why-multitasking-destroys-your-productivity-2/

Mays, N., & Pope, C. (1995). Rigour and qualitative research. *BMJ: British Medical Journal*, *311*(6997), 109–112.

Melby-Lervag, M., & Hulme, C. (2013). Is Working Memory Training Effective? A Meta-Analytic Review. *Developmental Psychology, 49*(2), 270-291.

Metz, S. M., Frank, J. L., Reibel, D., Cantrell, T., Sanders R., & Broderick, P. C. (2013). The effectiveness of the learning to BREATHE program on adolescent emotion regulation. *Research in Human Development, 10*(3), 252-272.

Misra, S. (2012). Randomized double blind placebo control studies, the “Gold Standard” in intervention based studies. *Indian Journal of Sexually Transmitted Diseases*, *33*(2), 131–134.

Morrison, A. B., Goolsarran, M., Rogers, S. L., & Jha, A. P. (2014). Taming a wandering attention: Short-form mindfulness training in student cohorts. *Frontiers in Human*

Neuroscience, 7, 897.

Mrazek, M. D., Franlin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science, 24,* 776-781.

Nayak, B. K. (2010). Understanding the relevance of sample size calculation. *Indian Journal of Ophthalmology*, *58*(6), 469–470.

Neary, T. J. (2013). *The effects of mindfulness meditation and resonant frequency breath training on emotion regulation and physiological responses* (Order No. 3596042).

Nemati, A. (2013). The effect of pranayama on test anxiety and test performance.

2, M. F., Farah, M. J. (2005). Neurocognitive correlates of socioeconomic status in kindergarten children. *Developmental Science, 8*, 74-87.

Norrish, J. M., & Vella-Brodrick, D. A. (2009). Positive psychology and adolescents: Where are we now? Where to from here? *Australian Psychologist, 44*(4), 270-278.

Peirce-Thompson, S. (2017). *Bright line eating: The science of living happy, healthy, and free.* New York: Hay House.

Posner, M. I. (1980) Orienting of attention. *The Quarterly Journal of Experimental Psychology, 32*(1), 3-25.

Prakash, R. S., Hussain, M. A., & Schirda, B. (2015.) The role of emotion regulation and cognitive control in the association between mindfulness disposition and stress. *Psychology and Aging, 30*(1) 160-171.

Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Gorber, S. C., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: a systematic review. *The International Journal of Behavioral Nutrition and Physical Activity, 5*(56), 1-24.

Quach, D., Jastrowski Mano, K. E., & Alexander, K. (2014). A randomized controlled

trial examining the effect of mindfulness meditation on working memory capacity in adolescents. *Journal of Adolescent Health,* 1-8.

Roese, N. J., & Olson, J. M. (2007). Better, stronger, faster self-serving judgment, affect regulation, and the optimal vigilance hypothesis. *Perspectives on Psychological Science : A Journal of the Association for Psychological Science*, *2*(2), 124–141.

Rossmaur, M. (2016). Learning a musical instrument helps enhance working memory. Retrived from https;//dm-ed.com/news/learning-a-musical-instrument-helps-enhance-working-memory/

Russell, T. A., & Arcuri, S. M. (2015). A neurophysiological and neuropsychological consideration of mindful movement: Clinical and research implications. *Frontiers in Human Neuroscience*, *9*, 282.

Saltzman, A. (in press). *Still Quiet Place: Manual for teaching mindfulness-based stress reduction to children.* Will be available in the context of workshops and trainings through www.stillquietplace.com.

Sass, S. M., Berenbaum, H., & Abrams, E. M. (2013). Discomfort with emotion moderates distress reduction in a brief mindfulness intervention. *International Journal of Behavioral Consultation and Therapy, 7*(4), 24-27.

Schooler, J. W., Mrazek, M. D., Franklin, M. S., Baird, B., Mooneyham, B. W., Zedelius, C., & Broadway, J. M. (2014). The Middle Way: Finding the Balance between Mindfulness and Mind-Wandering. *The Psychology of Learning and Motivation, 60,* 1-33. http://www.sciencedirect.com/science/bookseries/00797421.

Schonert-Reichl, K. A., Oberle, E., Lawlor, M. S., Abbott, D., Thomson, K., Oberlander, T. F., & Diamond, A. (2015). Enhancing cognitive and social-emotional development through a simple-to-administer mindfulness-based school program for elementary school children: A randomized control trial. *Developmental Psychology, 51*(1), 52-66.

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Houghton-Mifflin: Boston.

Shapiro, S. L. (2009). The integration of mindfulness and psychology. *Journal of Clinical Psychology, 65*, 555.

Shonin, E., Van Gordon, W., & Griffiths, M. D. (2014). The emerging role of Buddhism in clinical psychology: Toward effective integration. *Psychology Of Religion And Spirituality*, *6*(2), 123-137.

Siegel, D. J. (2013). *Brainstorm: The power and purpose of the teenage brain.* New York: Jeremy P. Tarcher/Penguin.

Singh, N. N., Lancioni, G. E., Winton, A. S., Karazsia, B. T., & Singh, J. (2013). Mindfulness training for teachers changes the behavior of their preschool students. *Research in Human Development*, *10*(3), 211-233.

Slavin, R. E. (2002). Evidence-based education policies: Transforming educational practice and research. *Educational researcher, 31*(7), 15-21.

Smyth, E., & Banks, J. (2012). High stakes testing and student perspectives on teaching and learning in the Republic of Ireland. *Educational Assessment, Evaluation And Accountability*, *24*(4), 283-306.

Spowart, S. A. (2014). *Long-term mindfulness meditation: Anxiety, depression, stress and pain, is there A connection for public health?* (Order No. 3615623).

Suchy, Y. (2009). Executive functioning: Overview, assessment, and research issues for non-neuropsychologists. *Annals of Behavioral Medicine, 37*(2), 106-116.

Teasdale, J. D., Segal, Z. V., Williams, J.M.G., Ridgeway, V.A, Soulsby, J. M., & Lau, M.A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology, 68*(4), 615-623.

Trapp, M., Trapp, E.-M., Egger, J. W., Domej, W., Schillaci, G., Avian, A., … Baulmann, J. (2014). Impact of mental and physical stress on blood pressure and pulse pressure under normobaric versus hypoxic ponditions. *PLoS ONE*, *9*(5), e89005.

Turner, M. L., & Engle, R. W. (1989). Is working memory capacity task dependent? *Journal of Memory & Language, 28*(2), 127-154.

Unsworth, N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. *Behavior Research Methods, 37*(3), 498 - 505.

Van Aalderen, J. R., Breukers, W. J., Reuzel, R. P. B., & Specken, A. E. M. (2012). The role of the teacher in mindfulness-based approaches: A qualitative study. *Mindfulness, 5*(2), 170-178.

Vogel, E. K., & Luck, S. J. (2002). Delayed working memory consolidation during the attentional blink. *Psychonomic Bulletin & Review, 9*(4), 739-743.

Volpe, R. J., DiPerna, J. C., Hintze, J. M., & Shapiro, E. S. (2005). Observing students in classroom settings: A review of seven coding schemes. *School Psychology Review, 34*(4), 454-474.

Williams, M., Teasdale, J., Segal, Z., & Kabat-Zinn, J. (2007). *The mindful way through depression: Freeing yourself from chronic unhappiness.* New York: Guilford Press.

Williams, P. G., Suchy, Y., & Rau, H. K. (2009). Individual differences in executive functioning: Implications for stress regulation. *Annals of Behavioral Medicine, 37*(2), 126-140.

Witt, M. (2011). School based working memory training: Preliminary finding of improvement in children's mathematical performance. *Advances in Cognitive Psychology, 7,* 7-15.

Woolley, M. E., Bowen, G. L., Bowen, N. K. (2004). Cognitive pretesting and the developmental validity of child self-report instruments: Theory and applications.

Research on Social Work, Practice, 14, 191–200.

Woolley, M. E., Bowen, G. L., & Bowen, N. K. (2006). The development and evaluation of procedures to assess child self-report item validity. *Educational and Psychological Measurement, 66,* 687-700.

Yosai, E. R. (2017). *Further investigating the underlying attentional processes of brief mindfulness-based interventions* (Order No. 10285760). Available from ProQuest Dissertations & Theses A&I. (1914686012).

Young, J. (2015). Why Do Athletes Have a Lower Heart Rate? Obtained from: http://www.livestrong.com/article/385209-why-do-athletes-have-a-lower-heart-rate/

Ysseldyke, J., Nelson, J. R., Christenson, S., Johnson, D. R., Dennison, A., Triezenberg, H., & ... Hawes, M. (2004). What We Know and Need to Know About the Consequences of High-Stakes Testing for Students With Disabilities. *Exceptional Children*, *71*(1), 75-94.

Zanesco, A. P., King, B. G., Maclean, K. A., & Saron, C. D. (2013). Executive control and felt concentrative engagement following intensive meditation training. *Frontiers in Human Neuroscience, 7,* 566.

Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z. & Goolkasian, P. (2009). Mindfulness meditation improves cognition: Evidence of brief mental training. *Conscious Cognition, 2,* 597-605.

Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools- a systematic review and meta-analysis. *Frontiers in Psychology, 5*(1), 1-20.

Appendices

Appendix A

Adolescent Demographic Questionnaire

Please complete the following items. All information is confidential.

1. Age (please circle one): 14 15 16 17 18

2. Grade (please circle one): 10th 11th 12th

3. Gender (please circle one): Male Female

4. Are you fluent in the English language (please circle one): Yes No

5. Do you have a documented visual impairment (please circle one): Yes No

6. Do you have any emotional problems for which you need help (please circle one): Yes No

7. **Are you currently under supervision of a mental health professional (please circle one):** Yes No

8. GPA at the end of the 2015-16 school year (please check one):

_____ A (100-90)

_____ B (89-80)

_____ C (79-70)

_____ D (69-60)

_____ F (Below 60)

9. Race/Ethnicity (please check one):

_____ African/African American/Black, non-Hispanic

_____ Latino/Hispanic

_____ Asian/Asian American

_____ Biracial (describe) _____

_____ Caucasian/ European/ White, non-Hispanic

_____ Native American/ Pacific Islander/ Eskimo

_____ Other (describe) _____

10. Amount of interest in mindfulness meditation (please check one):

_____Not at all interested

_____Not very interested

_____Neutral

_____Somewhat interested

_____Very interested

11. Previous experience with mindfulness meditation (please check one):

_____Never tried

_____Tried once or twice

_____Practice a few times a year

_____Practice a few times each month

_____Practice a few times a week

_____Daily practice

Thank you for your participation!

Appendix B

Passive Consent Form

Dear Parent/Guardian:

My name is Amanda Salazar, and I am a certified school psychologist, previously employed by the Valley Stream School District. I am now a Doctoral Student at Hofstra University's Psy.D. School-Community Program. I am dedicated to enhancing the lives of both parents and students alike through the utilization of mindfulness. Research thus far has illustrated that mindfulness is a viable path to self-compassion and may in turn lead to greater life satisfaction.

The research we are asking your son/daughter to participate in is an adapted version of the mindfulness based stress reduction program from the University of Massachusetts, Worchester. As part of this research students will be asked to answer questions related to mindfulness. In addition, attention will be evaluated by a short computer task and stress will be measured by pulse, all of which will be held in confidence. No risks or discomforts are anticipated. Nonetheless, any student that may experience discomfort will be able to see either their guidance counselor or the school psychologists. It is important to note that students are free to withdraw from this study at any point in time without penalty.

Mindfulness has been shown to enhance emotional resilience and positive health behaviors. In addition, it supports the strengthening and integration of self-regulatory skills, which is a vital aspect of social-emotional learning. The purpose of this research is to hopefully extend these findings and determine the impact of mindfulness on attention and perceived level of stress in the high school population. If we find further support that mindfulness aids in alerting, orienting, and executive control, it will give us more confidence in developing successful school-based programs.

We believe that this research is important and worthwhile. If for any reason you do not wish your son/daughter to participate in this research, please ask your son or daughter to return the attached slip to their physical education teacher.

Thank you for your time, courtesy and support.

Very truly yours,

Amanda L. Salazar, M.A.

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IF YOU DO ***NOT*** WISH YOUR SON/DAUGHTER TO PARTICIPATE IN THIS RESEARCH, PLEASE ASK YOUR SON/DAUGHTER TO RETURN THIS SLIP TO HIS/HER PHYSICAL EDUCATION TEACHER BY MONDAY SEPTEMBER 19TH.

Student's Name_____ Teacher_____Per. ___

(*Please Print)*

I prefer that my son/daughter ***not*** participate in this research.

Date:_____ Parent/Guardian
Signature:_____

Appendix C

Adolescent Assent Form

I invite you to participate in a groundbreaking study! Before you commit to participate, below is some information about the project.

WHO I AM:

My name is Amanda Salazar, and I am a student at Hofstra University. I am a school psychologist and working on my doctoral degree in school-community psychology.

WHAT WILL HAPPEN IN THE STUDY:

If you agree to participate, you will remain in your current physical education class. Also, you will be asked to:

1) Answer some questions about yourself.

2) Answer a few questions about mindfulness.

3) Complete a memory activity on the computer that will take about 20 to 25 minutes.

4) Read your pulse rate from a device called a pulse oximeter.

IT'S VOLUNTARY:

Your participation in this study is completely voluntary, which means that everyone will respect your decision of whether or not you participate in the study. If you choose to participate in the study now you can still change your mind at a later time without any penalties.

PRIVACY:

Everything you tell me during this project will be kept in confidence, which means that no one else will know your name or other identifying information. In addition, no one else will know your scores on the tasks or the answers you gave on the surveys.

ASKING QUESTIONS:

If you have any questions, you can ask them now or have your parents call the physical education department and request to speak with Ms. DeBetta.

I have read and I understand this form and I agree to be part of this project.

Name_____

Your signature_____
Date_____

Please sign form and return the form to the researcher.

Thank you for your participation!

Appendix D

Mindful Attention Awareness Scale (MAAS-A), trait version
(Brown, West, Loverich, & Biegel, 2011)

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.

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 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

To score the scale, simply compute a mean of the 14 items. Higher scores reflect higher levels of dispositional mindfulness.

Appendix E

Behavioral Probe

Is (name of student) _____ aligning his/her attention following a direct request? For example, is he/she able to follow along when given a specific direction, like silent reading.

Please circle one:

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

Appendix F

Sample Exercise
Eating One Raisin: A First Taste of Mindfulness

Holding: First, take a raisin and hold it in the palm of your hand or between your finger and thumb. Focusing on it, imagine that you've just dropped in from Mars and have never seen an object like this before in your life.

Seeing: Take time to really see it; gaze at the raisin with care and full attention. Let your eyes explore every part of it, examining the highlights where the light shines, the darker hollows, the folds and ridges, and any asymmetries or unique features.

Touching: Turn the raisin over between your fingers, exploring its texture, maybe with your eyes closed if that enhances your sense of touch.
Smelling Holding the raisin beneath your nose, with each inhalation drink in any smell, aroma, or fragrance that may arise, noticing as you do this anything interesting that may be happening in your mouth or stomach.

Placing: Now slowly bring the raisin up to your lips, noticing how your hand and arm know exactly how and where to position it. Gently place the object in the mouth, without chewing, noticing how it gets into the mouth in the first place. Spend a few moments exploring the sensations of having it in your mouth, exploring it with your tongue.

Tasting: When you are ready, prepare to chew the raisin, noticing how and where it needs to be for chewing. Then, very consciously, take one or two bites and notice what happens in the aftermath, experiencing any waves of taste that emanate from it as you continue chewing. Without swallowing yet, notice the bare sensations of taste and texture in the mouth and how these may change over time, moment by moment, as well as any changes in the object itself.

Swallowing: When you feel ready to swallow the raisin, see if you can first detect the intention to swallow as it comes up, so that even this is experienced consciously before you actually swallow the raisin.

Following: Finally, see if you can feel what is left of the raisin moving down into your stomach, and sense how the body as a whole is feeling after completing this exercise in mindful eating.

Williams, M., Teasdale, J., Segal, Z., & Kabat-Zinn, J. (2007). *The mindful way through depression: Freeing yourself from chronic unhappiness.* New York: Guilford Press.

Appendix G

Fidelity Checklist

Dates	Program Components	Completed
October, 2016 (Week 1 and 2)	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Taught students to use and understand the power of the breath in improving health and reducing stress in the mind and body. -Taught students to explore the fundamentals of mindfulness and how it relates to wellness and health. -Taught students to experience the way their body holds tension.	YES/NO YES/NO YES/NO YES/NO
October, 2016 (Week 1 and 2)	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Engaged students in full body conditioning through yoga postures; specifically muscular strength, flexibility and joint mobility. -Engaged students in practice that supports coordination and attentive body awareness. -Reviewed various strategies to help cope with stressors more effectively. -Taught students to investigate the effects of mind chatter (inner self talk) on attention and performance. -Taught students to comprehend the interrelationships between thoughts and feelings.	YES/NO YES/NO YES/NO YES/NO YES/NO YES/NO

	-Taught students to work with thoughts by observing them and letting them go.	
November, 2016 (Week 1 and 2)	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Engaged students in full body conditioning through yoga postures; specifically muscular strength, flexibility and joint mobility. -Engaged students in practice that supports coordination and attentive body awareness. -Taught students to understand the role our feelings play in our sense of wellness, balance and inner strength. -Taught students to understand and experience the rising and fading away of emotions. -Taught students to learn to work with emotions mindfully; both mental and physical approaches.	YES/NO YES/NO YES/NO YES/NO YES/NO YES/NO
November, 2016 (Week 3 and 4)	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Engaged students in the practice of mindful movement. -Taught students to understand key concepts about stress and the body's stress response. -Taught students to integrate knowledge about thoughts, feelings and sensations with the understanding of the stress processes.	YES/NO YES/NO YES/NO YES/NO YES/NO

	-Taught students to bring mindful awareness to the stressors in our lives. -Assisted students in developing patience, attention and anchored somatic attention.	YES/NO
December, 2016 (Week 1 and 2)	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Taught students to recognize the impact of emotional and physical effects on the body and mind. -Taught students to identify common stress indicators and stress related diseases. -Reviewed various strategies to help cope with stressors more effectively.	YES/NO YES/NO YES/NO YES/NO
December, 2016 (Week 3 and 4) *Winter break (one week) January, 2017 (Week 1 and 2)	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Taught students to identify ways to apply mindfulness to daily life. -Taught students to discuss ways of developing a personal mindfulness practice. -Taught students to connect mindfulness practice to self-care and care for others.	YES/NO YES/NO YES/NO YES/NO

January, 2017 (Week 3 and 4)	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Taught students to understand that the mind is a trainable organ. -Taught students to practice cultivating the mind in ways that support health, wellness and inner strength. - Taught students to learn ways to train the mind to support happiness and well-being.	YES/NO YES/NO YES/NO YES/NO
February through May, 2017	-Engaged students in the stress reduction activities of yoga and mindfulness meditation. -Taught students to understand that the mind is a trainable organ. -Taught students to practice cultivating the mind in ways that support health, wellness and inner strength. -Taught students to learn ways to train the mind to support happiness and well-being. -Taught students to identify ways to apply mindfulness to daily life. -Taught students to discuss ways of developing a personal mindfulness practice. -Taught students to connect mindfulness practice to self-care and care for others.	YES/NO YES/NO YES/NO YES/NO YES/NO YES/NO YES/NO