THE EFFECT OF A MINDFULNESS MEDITATION INTERVENTION ON

ATTENTION, AFFECT, ANXIETY, MINDFULNESS, AND SALIVARY

CORTISOL IN SCHOOL AGED CHILDREN

by

Maria L. Corbett

A Thesis Submitted to the Faculty of

The Charles E. Schmidt College of Science

in Partial Fulfillment of the Requirements for the Degree of

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Florida Atlantic University

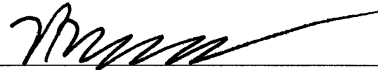Boca Raton, Florida

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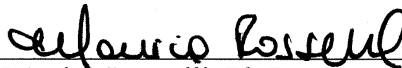# CORTISOL IN SCHOOL AGED CHILDREN

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Maria L. Corbett

This thesis was prepared under the direction of the candidate's thesis advisor, Dr. Nancy Aaron Jones, Department of Psychology, and has been approved by the members of her supervisory committee. It was submitted to the faculty of the Charles E. Schmidt College of Science and was accepted in partial fulfillment of the requirements for the degree of Master of Arts.
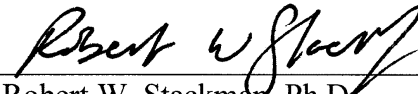
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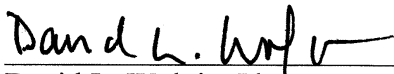
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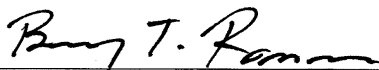
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ABSTRACT

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The current study utilized a quasi-experimental nonequivalent groups design to investigate whether a 5-week long Mindfulness Meditation Intervention (MMI), would impact measures of attention, positive and negative affect, state and test anxiety, mindfulness, and reactive cortisol levels in 107 school aged children. A series of reliability corrected ANCOVAs were performed on all behavioral variables. Results indicated that those in the MMI group did not differ from their cohorts on any of the behavioral measures.

Reactive levels of salivary cortisol were also collected and assayed in a subsample of 25 participants. An ANCOVA on cortisol change scores was performed and findings did not reach statistical significance. Post-hoc power analyses revealed that this could be due to inadequate sample size. To conclude studies utilizing a MMI of longer duration or with larger sample sizes may be required in assessing the usefulness of MMIs in behavioral and physiological measures in non-clinical child populations.

DEDICATION

I dedicate this manuscript to all those in my loving support system, for always encouraging me to push forward, even when it seemed like things had grown stagnant, I thank you all. Specifically, to my sister and best friend Melissa, thank you for always being there to listen to me vent, and for turning teary eyed moments of data frustration into laughter-filled moments instead. To my dear friend June Schell, for recognizing my intelligence and believing in me during times when I didn't believe in myself. To my friend Laxmi Lalwani, for reminding me that education is a part of life, not life itself. To my three wonderful RA's; Nohemi Medrano, Diana Lopez, and Leticia Valdes for working tirelessly and without college credits for several semesters in my lab. You are some of the greatest young women I have ever known and you will all go on to accomplish wonderful things in this life! And finally to my fiancé Ralph, meeting you has made my life complete. Your unconditional love and acceptance has made me a better human being. For that and so much more, I love you boo!!

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INTRODUCTION

School-related stressors impact children on a daily basis. With increased emphasis in schools on test performance, anxious feelings over exams and other evaluative procedures is not uncommon amongst school-aged children (Sarason, Davidson, Lighthall, Waite, & Ruebush, 1960). Unfortunately, tools to cope with school-based stressors often are not accessible within the classroom setting. However, a mindfulness meditation intervention (MMI) that teaches participants to train their attention while focusing on their breath appears to be a feasible class practice that could positively benefit students by engendering salubrious mind states and or by assuaging negative states of mind.

Contemplative practices such as mindfulness meditation (MM) have been taught to both adults and children in clinical populations, in part, to relieve symptoms of stress and anxiety (i.e., emotional dysregulation) as well as attentional deficits. From the success achieved in clinical populations, it has been extrapolated that children in non-clinical populations may benefit from these techniques as well during their own experiences with anxious situations. However, these hypotheses have not been empirically tested to date.

The proposed study sought to expand the sparse research conducted on children and mindfulness. It investigated the effects of a 5-week mindfulness intervention on self-reported levels of positive and negative affect, state anxiety, test anxiety, and mindfulness. Additionally, time scores on a sustained attention task were

assessed for improvements. Lastly, an assessment of salivary cortisol levels in a sub sample (N=25) of the participants was conducted to ascertain whether MM could augment the physiological response to stress.

Mindfulness and Meditation

Mindfulness

Mindfulness and the practices that help to cultivate it have roots in Buddhist doctrine. In Buddhism, mindfulness is known as one of the core components of the bodhipakkhiya dhamma, which are the 37 factors that make up ancient Buddhist Abhidharma theory. This theory has been defined as a sophisticated science of the mind that offers detailed explanations of the links between sensory perception and cognition (Goleman, 2003). According to the bodhipakkhiya dhamma, mindfulness has four stations (satipatthana), including mindfulness of the body, of feelings or sensations, of mind or consciousness, and of mental objects or qualities. It is common knowledge that Buddha himself believed that mindfulness was the path to the elimination of mental afflictions, and that training the mind was of the utmost importance. Although it seems that such vast and subjective claims would be difficult to support empirically, correlational studies have found a relationship between dispositional mindfulness and several adaptive qualities, including subjective well-being, cognitive flexibility, and emotional intelligence (Christopher, Charoensuk, Gilbert, Neary, & Pearce, 2009).

The subjective feeling of mindfulness isn't necessarily one of a state of relaxation, but one of heightened awareness toward the present moment (Langer & Moldoveanu, 2000). It is this 'mindful' mind that has links to well being, attention, and health, all which have been established in the literature (Brown & Ryan 2003;

Grossman, Niemann, Schmidt, & Walach, 2004; Jha, Krompinger, & Baime, 2007).

The Western perception of mindfulness is that it is a type of awareness to

presentmoment experience with an attitude of acceptance or nonjudgmentality (e.g.,

KabatZinn, 1994; Marlatt & Kristeller, 1999).

A more formal operational definition of mindfulness that has been agreed upon by

scholars also focuses on the components of awareness and acceptance (Bishop et al., 2004).

Awareness, or the continuous monitoring of one's current experiences

(Deikman, 1996), is the actual behavioral component. Attention is said to play a key

role in achieving this state and, in turn, the practice of mindfulness helps sharpen

attention regulation skills (Austin, 1998). In fact, focused attention and mindfulness

achievement are so intertwined that it is impossible to parcel them from one another as they

each are catalysts for the other.

The second component of acceptance, defined here as the experiencing of events

without resistance, also relies on one's attentional capabilities, but also has direct ties to

emotional regulation as well. This is especially true when one experiences distress.

Instead of coping with a reactive mind, which often relies on patterns of emotional

dysregulation, employing mindful attention helps to reverse this process and engender

positive emotions (Linehan, 1993). Thus, mindfulness might mediate emotional

regulation through biasing one to think more positively, while simultaneously reducing

negative thinking.

Mindfulness Meditation

One way of cultivating a more mindful mind is via the practice of meditation.

Although the first origins of meditation are unknown, the practice can be traced back at

least 3,000 years. It is but one of many 'contemplative practices,' which also include mindful walking, yoga, focused experiences in nature, and contemplative physical or artistic expressions. All of these practices are designed to quiet the mind in the midst of the stress and the distractions of everyday life. It has been said that these practices have the capability of creating deep concentration and insight in individuals, leading to the development of compassion and optimal states of psychological well-being.

The term "mindfulness meditation" (MM) refers to a subfamily of practices that train attention in order to heighten awareness and bring mental processes under greater voluntary control (Walsh, 1983). During MM, therefore, one experiences all stimuli, including one's own thoughts, through a nonjudgmental lens, where attention is fully brought to the present moment. During this time any impinging stimuli are not analyzed or dissected by the mind, but are simply allowed to 'be' through acceptance and acknowledgement of their presence. Even MMI of short duration has been found to boost the self-reported mindfulness of individuals, with lasting effects in some cases. For example, a 10-day intensive MM training with adults resulted in increased reporting of mindfulness (Chambers, Yee Lo, & Allen, 2008). Similarly it has been found that two different types of mindfulness-based interventions cultivated more sustained mindfulness during an 8-week follow up, as compared to controls (Shapiro, Oman, Thorese, Plante, & Flinders, 2008).

Mindfulness and Attention

Attentional skills are enhanced during the present moment awareness necessary to attain a mindful mind, thus contributing to the development of attentional control mechanisms (Baer, 2003). Mindfulness also has been found to bring about

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improvements in sustained attention and attention switching (Bishop et al., 2004). It has been noted that attentional skills can be increased through the practice of MM, and these skills have been observed and honed in both adult and child populations. Attention mediates meditative practices, and some have referred to attention as the primary psychological domain that is impacted by meditation (Davidson & Goleman, 1977). Others have said that attention is the essence of mindfulness itself (Semple, Reid, & Miller, 2005).

Successful meditative practices require attentional mechanisms necessary to sustain focus during the exercises and by continuing to practice focused attention, those skills are anticipated to improve over time. Indeed, past studies have found that both children and adults who were long-term meditators had superior performance during the Embedded Figures Test, which requires participants to block out distracting stimuli (Kubose, 1976; Linden, 1973). Some evidence exists that those who perform MM have better sustained attention skills to unexpected stimuli, compared to those that practice other forms of meditation or no meditation at all (Wilkins, Shallice, & McCarthy, 1987; Valentine & Sweet, 1999). Results also have surfaced in child populations, illustrating that MMIs have the capability to increase children's scores on divergent thinking tasks (Grant, 2004; Fisher, 2006). Additionally, clinical child populations have benefited from MMIs as treatment for attention deficits and attention deficit hyperactive disorder (ADHD) (Chambers et al., 2008; Zylowska et al., 2008).

Support also has been found that there are structural changes in the brain that take place over time as a result of MM practice, which may impact the enhanced attentional capabilities often found amongst practitioners of mindfulness. For example,

a study using functional magnetic resonance imaging (fMRI) found that meditation activates several structures in the brain that are implemented in attention, including lateral prefrontal and parietal regions (Lazar et al., 2000). In addition, evidence from other neuroimaging studies, as well as those utilizing EEGs, support the view that mindfulness training can result in neural changes that are related to enhanced attention capabilities (Davidson et al., 2003; Farb et al., 2007; Jha et al., 2007).

Mindfulness and Emotional Regulation/Affect

Broadly defined, emotional regulation can be viewed as the flexible and adaptive regulation of emotions induced by environmental demands (Thompson, 1994). Mindfulness is, in essence, the practice of bringing focused awareness to emotional experiences using nonjudgmentality; this, in turn, may facilitate a healthy engagement with emotions (Hayes & Feldman, 2004). Additionally, there are clear indications that, much like attention, emotion regulation plays a large part in mediating the effects of mindfulness (Coffey & Hartman, 2008; Arch & Craske, 2006).

It appears that even short term MM training can impact emotional regulation and affect. A study done assessing the impact of a 15 minute mindful breathing exercise on emotional regulation found that during a slide presentation thereafter, those in the mindful group viewed neutral pictures as more positive and negative pictures as less negative than all other groups (Arch & Craske, 2006). The long term practice of MM also has been shown to create neural changes that result in positive affect in adults (Davidson et al., 2003; Farb et al., 2007; Jha et al., 2007). Since children often experience emotions more intensely than adults (Fisher, 2006), emotional regulation early in life is thought to be the key to avoiding future maladaptive coping strategies in

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adulthood, and it appears that MM maybe a probable mechanism for enhancing its development.

Mindfulness as an Intervention

Over the past 30 years, various authors have proposed approaches to counseling and psychotherapy practice rooted in this and similar Buddhist philosophy (e.g., Daya, 2000; Nissanka, 1993; Welwood, 2000). Meta-analyses have revealed that these contemplative practices are useful in reducing symptoms associated with not just psychological, but medical conditions as well (Baer, 2003; Grossman et al., 2004). MM practices have been shown to boost immune system functioning (Davidson et al., 2003; Carlson, Speca, Patel, & Goodey, 2003, 2007), which provides some insight as to why these practices successfully treat chronic pain (Kabat-Zinn, Lipworth, & Burney, 1985; Kabat-Zinn, Lipworth, Burney, & Sellers, 1987), fibromyalgia (Goldenburg et al., 1994; Astin et al., 2003), and psoriasis (Kabat-Zinn et al., 1998).

Some popular treatment techniques incorporating mindfulness include Jon Kabat-Zinn's Mindfulness-Based Stress Reduction (MBSR) program, which helps to treat anxiety (Kabat-Zinn, 1990; Miller, Fletcher, & Kabat-Zinn, 1995); Marsha Linehan's Dialectic Behavioral Therapy (DBT) to treat borderline disorders (Linehan, 1993), and Steven Hayes's acceptance and commitment therapy (ACT) (Hayes, Strosahl, & Wilson, 1999). MMIs also have been utilized, in part, for relapse prevention of depression and substance abuse (Segal, Williams, & Teasdale, 2002; Marlatt, 2002), treatment of generalized anxiety disorder (Roemer & Orsillo, 2002), attention deficit hyperactive disorder (Semple et al., 2005; Zylowska et al., 2008) and conduct disorder (Singh et al., 2008).

As abovementioned, due to the stress-relieving benefits of MMI, it has been used robustly in both clinical and adult populations to treat anxiety (Kabat-Zinn, 1990; Miller et al., 1995), but less is known about the effectiveness of these techniques with children. It has been said that when students successfully experience a 'mindful' mind, their ability to focus and cope with stressful situations increases (Langer, 1993). This is caused, in part, by a reduction in ruminative thinking coupled with openness to the current experience that is cultivated by mindfulness (Bishop et al., 2004; Segal et al., 2002; Teasdale, Segal, & Williams, 1995). Additionally, a study done with college students found that reductions in perceived stress were coupled with reductions in ruminative thinking in those who participated in the MMI, as compared to the no treatment control group (Oman, Shapiro, Thoresen, Plante, & Flinders, 2008).

Additionally, findings by Singh et al. (2008) show promise for mindfulness techniques as treatment for adolescents with conduct disorder. Simply by redrawing a participant's focus to their foot, it was found that decreases in verbal and physical aggression were reported even after a follow-up inquiry was conducted four years later. Similarly, Sanchez-Penagos (2008) found that after a 10-week MMI in a non-clinical child population, teachers reported those students who partook in the MMI were less aggressive than the control group who received no intervention at all. These techniques may work on aggressive behaviors by simply taking the participants out of reactive mind patterns and heightening awareness of their current emotional state. Taken together, these findings support that mindfulness techniques alone, or in part with other treatments, are successful amongst varied clinical populations, and are beginning to

show promise in their ability to alter behavioral patterns in non-clinical populations as well.

The Physiological Response to Stress

Up until this point, most investigations into the success of MMIs have relied solely on self-reported measures of both the physical and psychological benefits of MM. While these can be of benefit, they are based on subjective assessments of the patient's or participant's thoughts and feelings. Since the hormone cortisol is released in response to stress, it has begun to be investigated as a potential objective marker of success for programs that incorporate mindfulness techniques, such as Kabat-Zinn's (1990) MBSR. In fact, Matousek, Dobkin, and Pruessner (2010) recently reviewed the role of cortisol as an indicator and concluded that it should be used in conjunction with self-reported measures to validate the success of these types of programs. Therefore, incorporated into the current study were both basal and reactive levels of salivary cortisol, analyzed from a subset (N=25) of participants. This next section will briefly review the mechanics of the stress response, the negative impact of cortisol during development, and stress triggers, and will begin to explore the physiological links to test anxiety.

Definition of Stress

Stress can be simply defined as a collection of events, consisting of stimuli that precipitate a reaction in the brain, leading to the activation of the physiological fight/flight response, which results in changes in the body (Dhabhar & McEwen, 1997). When an organism feels it is under physical or psychosocial threat, the limbic hypothalamic-pituitary-adrenocortical axis (HPA) is one of two mammalian stress

systems that becomes activated in response to said threat; and it is activation of this system that results in the release of cortisol into the body. From a biological perspective, the activation of the HPA is viewed as beneficial and adaptive (McEwen & Seeman, 1999) as maintaining physiologic balance is essential to health (Sapolsky, 2004). Cortisol, in particular, allows for an organism to properly respond to a threat or uncertainty by increasing alertness, breathing, and heart rate (Sims, Guilfoylem, & Parry, 2005). Cortisol also exerts both short- and long-term effects on memory and learning, as well as long term effects that impact the neural circuits that play roles in modulating the stress response itself, emotions, and memory via regulation of gene expression in these circuits (Sapolsky, Romero, & Munck, 2000; Stansbury & Gunnar, 1994).

Cortisol and Development

Chronic or sustained activation of the HPA axis in certain individuals can cause deleterious health consequences both psychologically and physically. It has been duly noted that a dysregulated HPA plays a role in depression, anxiety disorders, and substance abuse, and may contribute to cardiovascular disease, hypertension, stroke, and diabetes (McEwen, 2002, 2007). Empirical data are beginning to tell the tale of just how much of a linkage exists between cortisol and disordered behaviors across developmental periods in human populations. The dysregulation of the HPA and the resulting high levels of cortisol in a child's system are considered to be even more damaging than to that of the adult, as elevated cortisol levels have been shown to have a detrimental influence on the developing architecture of the brain (Chugani et al., 2001). Specifically, excessive cortisol exposure can influence the development of

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neurotransmitters and nascent pathways in the brain (Gerhardt, 2004) and ultimately alter threat perception and future sensitivity to stress.

Behaviorally, these negative brain modifications also may contribute to childhood anxiety, depression, and obesity. Social anxiety, in which a person experiences anxious feelings in regard to social interactions and evaluative judgments from others, was particularly associated with higher levels of salivary cortisol during a conflict task (Granger, Stansbury, & Henker, 1994). Those afflicted with anxiety, who also display anxiety symptoms during a stressor task, also have higher cortisol concentrations compared to those with no anxiety or anxiety without present symptoms (Coplan et al., 2002). In addition, Feder et al. (2004) found associations between anxiety symptomology and higher levels of basal cortisol in children. High basal cortisol levels also have been associated with both internalizing and externalizing problems in children (Stansbury & Gunnar, 1994). HPA axis dysregulation also has links to both obesity and depression, suggesting that their comorbid diagnoses are not happenstance (see Bornstein, Schuppenies, Wong, & Licinio, 2006 for review). Taken together, these findings support that HPA dysregulation can lead to deleterious consequences.

HPA Triggers

HPA stress axis activation has very specific physical as well as psychosocial triggers. Therefore, studies assessing the effectiveness of stressor paradigms, as measured by levels of reactive cortisol, do not always yield significant results, even if a standardized stressor paradigm is employed (see Gunnar, Talge, & Herrera, 2009 for review). This is due, in part, to the fact that HPA activation during psychological or

psychosocial events is highly subjective and inconsistent amongst groups of individuals. Unlike physical challenges to homeostasis, which elicit a direct physiological response, reactions to psychological stressors can occur if there is even the perception a threat is looming, regardless of whether this perception is justified (Sapolsky, 2004).

Individual differences aside, successful stressor paradigms do exist and can yield significant results. In a meta-analysis, Dickerson and Kemeny (2004) uncovered that performance tasks that elicited the largest reactive cortisol levels were those tasks that were defined as uncontrollable and characterized by social evaluative threat (task performance could be judged negatively by others). For example, laboratory tasks such as mental arithmetic or public speaking have been found to significantly increase cortisol (Kirschbaum, Pirke, & Helhammer, 1993) and unlike some paradigms, these reactions are sustained across several age brackets (Gunnar et al., 2009).

HPA Triggers at School

In schools, it has been uncovered that the anticipation of school alone not only raises cortisol levels even months prior to actual classroom entrance, but for some children this response is sustained and chronic for as long as six months into school attendance (Turner-Cobb, Rixon, & Jessup, 2008). Additionally, factors such as classroom size, teacher-student relationships, and perceptions about the teacher (i.e. friendly, cold, etc.) can all impact levels of cortisol in school-aged children (Lisonbee, Mize, Payne, & Granger, 2008). Due to the fact that high levels of cortisol appear disadvantageous for a child's developing system, it is important to consider factors that might influence activation or dysregulation of the HPA while children spend time away from home.

Exams are one real world example of a stressor that students encounter on a daily basis, and which also have the potential ability to trigger an HPA stress reaction. Particularly, exams and other evaluative processes contain the element of unpredictability over exactly what material will be covered on the exam and the probability of social evaluative threat occurring by both teachers and fellow classmates, especially if performance is poor. If a student does perform poorly, the chances of HPA activation may increase due to feelings of shame, embarrassment, and negative self evaluations that may occur. In children as young as 4 years old, it was found that those who didn't complete a task in time suffered from evaluative embarrassment and shame, and these feelings were subsequently related to higher levels of cortisol (Lewis & Ramsay, 2002).

In both high school and college populations, it has been found that a rise in cortisol production has been associated with exam periods at school (Frankenhaeuser et al., 1978). Further, these elevated glucocorticoid levels have been found to have a dynamical impact on learning and memory (Stansbury & Gunnar, 1994). Initially, low to moderate levels of stress axis response may help increase such things as energy, concentration, and heightened attention to the environment. However, over time there is a decrease of energy, inability to concentrate, and an increase in depressive symptoms (Wolkowitz et al., 1998). Additionally, when there is a more intense response to stress—causing corticoids to rapidly reach excessive levels, disruption in learning and adaptation may be present due to the impact of these hormones on concentration and memory (Stansbury & Gunnar, 1994).

Characteristics of Test Anxiety

In some, concerns over evaluations of poor performance can reach detrimental levels and can take on the form of test anxiety. Test anxiety (TA) has been defined as a situation-specific trait directly linked to anxiety and worry states experienced during exams (Spielberger & Vagg, 1995). Most people experience some form of TA at some point throughout their education and this often is viewed as a part of academic life. However, students with fairly high levels of TA do not perform optimally on exams (Hancock, 2001); TA can even impede a student's ability to learn (Sub & Prabha, 2003). Specifically, during evaluative situations, those students with test anxiety are afflicted with more tension, fear, and worry than other students (Spielberger & Vagg, 1995).

The construct of test anxiety has grown increasingly more complex over the years and a multidimensional model is now the most widely accepted (Benson, 1998; Zeidner, 1998). Test anxiety initially was viewed strictly through the lens of a cognitive-attentional model. This model emphasized that test anxiety originated from an attentional deficit in which students would divide their attention between thoughts relevant to the task at hand and worries about their performance (Wine, 1977). In the 1980s, another paradigm was proposed that stated test-anxious children are that way because of poor study habits and poor test taking skills, which lead to repeated test failures and, subsequently, to TA (Benjamin, Mckeachie, Lin, & Holinger, 1981; Kirkland & Hollandsworth, 1980). Other suppositions include an emphasis on self-regulation (Carver & Scheier, 1991) and self worth (Covington, 1992).

Factors such as the perceived difficulty of the test, the likelihood of negative performance evaluations from others, and exam importance all contribute to the perceptions of how threatening a particular test is. This perceived evaluative threat influences subsequent levels of test anxiety (Hancock, 2001) much in the way that it activates the HPA system; the more threatening a situation, the greater the chance a cortisol reaction will occur in response. Another closely related variable thought to be included in the construct of TA, which also has ties to HPA reactivity, is fear over social humiliation (Friedman & Brendas-Jacob, 1997) that might come with test failure.

Physiological hyperarousal also makes up a portion of the test anxiety construct (Joiner et al., 1999). Symptoms of this can present themselves as increased perspiration, hypo- or hyper-respiration, and increased heart rate (Lowe et al., 2008). An additional physiological component to consider would be the occurrence of HPA reactivity during bouts of TA. Short-term findings utilizing salivary cortisol and its relation to exams exist in the literature (Spangler, 1997) and numerous studies have established that a relationship between cortisol levels and exam periods do exist long term as well. For example, it has been evidenced that plasma cortisol values display an elevated trend pattern during days and even weeks in which exams take place, suggesting a long term activation of the adrenocortical system (Helhammer, Heib, Hubert, & Roef, 1985; Meyerhoff, Oleshansky, & Mougey, 1988; Johansson, Laakso, Peder, & Karonen, 1989). Children are under tremendous pressures to excel in their school environments as well as on the home front and can display physiological symptoms tantamount to their adult counterparts when they experience distress (Miller & McCormick, 1991). This could lead to maladaptive activation of the HPA axis and or hypersensitivity to stressors

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that normally would not be engaging the stress systems.

Mindfulness Meditation and the HPA

Meditation activates several brain structures that also modulate the HPA axis including portions of the prefrontal cortex, hippocampus, and the amygdala (Lutz, Slagter, Dunne, & Davidson, 2008). However, the exact contribution of these brain regions during meditation is not well defined. Prior work has uncovered that meditation can lower cortisol levels in adults (Handlon et al., 1962; Sachar, Fisherman & Mason, 1965; Sudsuang, Chentanez, & Veluvan, 1991;Walton, Pugh, Gelderloos, & Macrae, 1995), but whether these practices are effective in children is not clear. Additionally, it has been found that meditation practices also reduce plasma and urine levels of norepinephrine (NE) (Walton et al., 1995; Infante et al., 2001) released by the sympathetic adrenal medullary stress system (SAM). It has been hypothesized that it is this reduction of NE output from the locus ceruleus to the paraventricular nucleus (PVN) of the hypothalamus, that results ultimately in a reduction of cortisol (Newberg & Iversen, 2003).

As previously mentioned, individual differences in threat perception exist, and it appears that attention plays a role in the act of threat perception itself. Those who have a disposition to see situations as more threatening may pay more attention to threatening stimuli in their environment or interpret situations as threatening that aren't. Theoretically, perceptions like these can lead to a chronic or sustained HPA activation. However, it is possible to attenuate the vigilance and responsiveness to social threat by manipulating one's attention to the stimuli (Dandeneau, Baldwin, Baccus, Sakellaropoulo, & Pruessner, 2007). In fact, the authors uncovered that cortisol release

in response to social threat correlated positively with selective attention toward said threat. These findings, coupled with the increased attentional and emotional regulation capabilities that are improved as a result of MMIs, support that MM should be able to alter threat perception and therefore subsequently HPA activation.

Aims and Predictions of the Current Study

Although the positive benefits of mindfulness interventions have been duly noted in adult populations, few studies exist that have begun to examine the effects of this intervention in young children. The studies that do exist with elementary school age children take place largely within clinical populations and have a very low number of participants (Ott, 2002; Semple et al., 2005; Singh et al. 2007, 2009). Of those that have taken place in non-clinical populations, the studies conducted thus far either have no control groups (Lee et al., 2008), incomplete data analysis (Saltzman & Goldin, 2008) or don't specify pre-test group equivalence even when condition assignment was via classroom subscription and not true random assignment (Napoli et al., 2005). Studies with children slightly older are plagued with many of the same issues (see Burke, 2009 for review). Further, physiological measures have been put forth as a new and necessary barometer of MMI success, however, these measures have failed to make there way consistently into developmental studies in the MMI literature.

These empirical oversights seem curious for two reasons. First, it has been established in the adult literature that meditation has been found to modulate the HPA axis and associated stress systems (Black, Milam, & Sussman, 2009). It seems likely then that children should be able to benefit from these techniques in ways much like adults do, during a period of time when their HPA is even more plastic than that of their

adult counterparts. The second is that stress reduction programs implemented in the school setting have resulted in many improvements in school aged children's academic performance, ability to concentration, mood states, and self-esteem (as cited in Napoli, et al., 2005). This illustrates that the mindfulness techniques that are utilized for stress reduction, may also help foster the burgeoning of developmentally-specific achievements, such as attention, self-awareness, and emotional regulation.

It was the main goal of the present study to take findings on MMIs in adult and clinical child populations and extend them to a non-clinical sample of school -aged children. Due to the fact that psychological stress is experienced when a situation is perceived as threatening, or the looming threat surpasses an individual's coping resources (Folkman & Lazarus, 1988), it is important to provide children with the proper coping mechanisms that will arm them to interpret and handle daily stressors in a healthy way. Theoretically, classroom based MMIs may aid in the development of these much needed mechanisms, but empirically supported conclusions are needed before schools will consider adding mindfulness training to the curriculum. Two secondary goals are to explore whether the usage of a 'pop quiz' paradigm is a sufficient stressor paradigm (as assessed by stressor cortisol levels) and whether the physiological measure of cortisol could be used as a feasible marker of MMI success as it has been in adult studies of MBSR.

Therefore, the current study is designed to test whether a MMI will impact self-reported measures of affect, state and text anxiety, mindfulness, and sustained attention immediately following a school-based stressor task. Basal and reactive salivary cortisol samples will be collected and analyzed from a subsample of participants in order to

determine if the stressor paradigm was successful in engendering an HPA response, as well as to ascertain whether the MMI had an impact on their physiological response to stress. Correlations between the construct of mindfulness and the respective physiological and self-reported behavioral measures also will be explored.

Hypotheses and Predictions

      Behavioral measures. Anxiety. It has been found that mindfulness-based therapies are effective in reducing anxiety and stress in adult populations (Baer, 2003). In addition, small scale studies conducted within child populations have revealed significant reductions in self reported amounts of both state and test anxiety (Linden, 1973; Napoli et al., 2005; Semple, Lee, Rosa, & Miller, 2009). Based on those findings, it was hypothesized that the current MMI would result in a change in the amount of self-reported state and test anxiety. Specifically, it was predicted that there would be a significant decrease in scores on the state portion of the state trait anxiety measure for children (STAIC), similar to those found in prior studies, as well a significant decrease in scores on the test anxiety scale for children (TAS-C) in those in the MM group compared to controls at posttest.

      Positive and negative affect. Recent studies have revealed alterations in both positive and negative affect after MMIs. Schonert-Reichl and Lawlor (2010) found increased levels of self-reported positive affect and optimism in school age children enrolled in a MMI compared to controls; however, there were no significant changes in negative affect. Conversely, Broderick and Metz (2009) found a reduction in self-reported negative affect between their MMI and control groups, but no significant changes in positive affect. Therefore, it was hypothesized that the current MMI would

result in a change in the amount of self-reported positive and negative emotions on the positive and negative affect scale (PANAS-C). It was predicted that the scores on the positive emotion subscale will increase significantly and scores on the negative emotion subscale will decrease significantly in the MM group when compared to controls at posttest.

Mindfulness. H1: Prior research on MM has uncovered that interventions of both short (Chambers et al., 2008) and longer length (Shapiro et al., 2008) MM practice can result in increased levels of self-reported mindfulness. It was hypothesized, therefore, that the current MMI would result in changes in self-reported levels of mindfulness. Specifically, it was predicted that there would be a significant increase in scores on the Child Mindfulness and Acceptance Measure (CAMM) in those in the MM group compared to controls a posttest.

H2: It was hypothesized that levels of self-reported mindfulness scores on the CAMM will be related to scores on the affect and anxiety measures. Specifically, it is predicted that in the sample overall mindfulness scores would be positively correlated with reported levels of positive emotions on the PANAS-C positive subscale, negatively correlated with reported levels of negative emotions on the PANAS-C negative subscale, and negatively correlated with STAIC and TAS-C anxiety scores. These predications are based on a meta-analysis of findings in adult populations (Grossman et al., 2004).

Attention. MM has been found to increase sustained attention skills in adults (Valentine & Sweet, 1999) as well both sustained and selective attention in elementary school age children (Napoli et al., 2005). Therefore, it was currently hypothesized that

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the current MMI would result in a change in the amount of time recorded to complete a sustained attention task. Specifically, it was predicted that there would be a significant decrease in completion time on the children's color trails test (CCTT) for those in the MM group compared to controls at posttest.

Physiological measure. Cortisol. H1: Based upon meta-analytic findings (Dickerson & Kemeny 2004) and a broad literature review (Gunnar et al., 2009), it was hypothesized that the current pop quiz paradigm introduced in this study met the criteria to successfully engender an HPA response to stress in both the MM and control groups at pretest.

H2: Prior work with adult populations has uncovered that meditation can lower both cortisol levels (Handlon et al., 1962; Sachar et al., 1965; Sudsuang et al., 1991; Walton, Pugh, Gelderloos, & Macrae, 1995), as well as norepinephrine (Walton et al., 1995; Infante et al., 2001) released by the SAM stress system. Therefore, it was hypothesized that the current MMI would result in a change in the amount of reactive cortisol obtained after the pop quiz stressor task in the MM group. Specifically, it was predicted that there would be a significant decrease of reactive cortisol levels in those in the MM group compared to controls at posttest.

METHOD

Participants

One hundred and seven students from Henderson Elementary School volunteered for the study across two semesters. Five classes of 5th graders and three classes of 4th graders partook in the study, of which five classes were assigned to the experimental condition and three to the control condition. There were 57 male and 50 female participants, who ranged in age from 8-11 years old (M age = 9.94 years, SD = .76), participated in the study, of which 24 male and 20 female participants were assigned to the control condition and 33 male and 30 female students were assigned to the experimental condition. The mean ages for the two groups were 10 and 9.90, respectively. Additionally, a subset of participants, consisting of 12 male and 13 female participants who ranged in age from 10-11 years old (M = 10.88, SD = .331), was chosen for cortisol analyses.

Instruments

State Anxiety

The state portion of the State-Trait Anxiety for Children (STAIC) (Spielberger, 1973) was administered. It is designed to assess state anxiety for children and contains two scales of 20 items each. The STAIC-State scale is constructed to ask children how they feel at a particular moment in time. Scores range from 1 to 3 per item, with negative attributes being reverse scored. For example, "I feel very nervous, nervous, not nervous" would be scored 3,2,1, whereas "I feel very calm, calm, not calm" would be

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scored 1,2,3. Scores can range from 20-60. The lower the total score, the less reported anxiety. The alpha reliability of the STAIC S-Anxiety scale computed was .82 for males and .87 for females. The reliability of this measure was currently assessed with this study's participants at both pre and posttest and the Cronbach's alphas were .897 and .857, respectively.

Test Anxiety

The Test Anxiety Scale for Children (TASC) (Sarason et al., 1960) was administered. The TASC was developed from the general anxiety scale for children in order to assess fears specifically generated in school settings. It is a 30-item yes/no scale for use with children in grades 1-9, and has a range of scores from 0-30. The higher the score, the greater the reported amount of test anxiety. It has good split-half reliability (0.91) and its construct validity is well supported. The reliability of this measure was additionally assessed with the current study's participants at both pre and posttest and the Cronbach's alphas were 0.923 and 0.890, respectively.

Emotional Regulation/Affect

The Positive and Negative Affect Schedule for Children (PANAS-C) (Laurent et al., 1999) was administered. The PANAS-C is a 30-item self-report scale that measures both positive and negative affect, as indicated by ratings of single words on a 1 to 5 Likert scale according to their personal relevance. Scores can range from 15-75 for each subcategory. The higher the score, the greater the amount of positive or negative affect reported. It has been shown to have good reliability, with Cronbach's alphas being 0.94 for positive affect and 0.92 for negative affect, respectively.

Mindfulness

The Child Acceptance and Mindfulness (CAMM) (Greco, Dew, & Ball, 2005), a 25-item measure of acceptance and mindfulness, assesses the degree to which children and adolescents observe internal experiences, act with awareness, and accept internal experiences without judging them. Participants respond to particular statements on a 5-point Likert scale ranging from 0 indicating never true to 4 indicating always true. A total score is calculated by summing the item total, after reverse scoring several indicated negatively worded items. Scores may range from 0-100, with higher scores indicating a greater degree of acceptance and mindfulness. The CAMM demonstrates good internal consistency, with Cronbach's alpha = 0.87; research using the CAMM suggests the measure has good concurrent validity.

Sustained Attention

All participants partook in the Children's Color Trail Test (CCTT) (Llorente, Williams, Satz, & D'Elia, 2003). This test is designed to assess sustained attention, sequencing, and other executive skills in 8-16 year olds, while reducing reliance on language and diminishing the effects of cultural bias and parental verbal reports. Time scores were used and analyzed in this current study. Reliability between form X for the CCTT-1 and the CCTT-2 is 0.90. CCTT demonstrates a good level of convergent validity with the Children's Trail Making Test (CTMT) and other instruments designed to assess attention.

Salivary Cortisol

Salivary cortisol levels were collected with the Salivette sampling device (Sarstedt Inc., Rommelsdorf, Germany). All samples were assayed for salivary cortisol

in duplicate using a highly sensitive enzyme immunoassay (Salimetrics, PA). The test uses 25 µl of saliva per determination, has a lower limit of sensitivity of 0.003 µg/dl, standard curve range from 0.012 to 3.0 µg/dl, and average intra-and inter-assay coefficients of variation 3.5 % and 5.1 %, respectively. Method accuracy, determined by spike and recovery, and linearity, determined by serial dilution, are 100.8 % and 91.7 %. Values from matched serum and saliva samples showed the expected strong linear relationship, r (63) = 0.89, p < 0.0001.

Design and Statistical Analysis

A quasi-experimental, nonequivalent groups design (NEGD) was utilized to evaluate all hypotheses. This design encompassed the pre-post measurements of several dependent behavioral variables including, attention, negative and positive affect, state anxiety, test anxiety, and mindfulness, as well as pre-post measurement of the physiological variable cortisol, which was analyzed in a subset of participants (N=25). The current study was made up of two distinct groups: a MMI group and control group, which also represent the two levels of the independent variable, 'intervention.'

As with any study design, the NEGD has both strengths and weaknesses. The major benefit of this design is that it can be used in applied research settings, while still allowing one to compare the effects of an intervention across groups, just as if it were a true experiment. However, because random assignment is not used in these designs, vulnerability to the internal validity threat of selection increases (Trochim & Donnelly, 2007). Selection threat or bias is defined herein as any factor other than the intervention that could lead to posttest differences between groups, including pretest group differences. This selection threat, therefore, poses a conundrum, for which statistical

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corrections must be made.

On the surface, NEGDs can be structured almost identically to pretest - posttest designs, and so it may appear that repeated measures analysis of variance (RMA) should be the statistic of choice. However, in the current study that assumption is incorrect for two reasons. First, RMAs are only appropriate in pretest / posttest designs when multiple posttest measures are collected on the same dependent variables. Since the current study did not meet these criteria, it was found that the only interpretable statistic within the RMA was the time x condition interaction, which in actuality represents the main effect of condition in this study design, with F values identical to analysis of variance (ANOVA) conducted on difference scores (Dimitrov & Rumrill, 2003). Second, as mentioned above, due to the lack of random assignment, it is recommended that an analysis of covariance (ANCOVA) be applied in these designs, with pretest measures as the covariates.

However, ANCOVAs can be biased in NEGDs due to the combination of pretest measurement error and group nonequivalence. Subsequently, both the classic ANCOVA as well as ANCOVAs on difference scores also have been the subject of criticism (Jamieson, 2004). An alternative to these options is the use of reliability corrected pretest measures as the covariates (Trochim & Donnelly, 2006). Therefore, a series of ANCOVAs, in which the reliability correction was made to reduce pretest score measurement error, were conducted on all the behavioral data including test anxiety, state anxiety, positive and negative affect, mindfulness, and attention. Test - retest reliabilities were calculated and used to transform the variables, as this type of reliability tends to be a lower bound estimate. In addition, Cronbach's Alpha also was

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utilized when available, as this is a more upper bound estimate of reliability (Trochim & Donnelly, 2006). The transformation formula used was:

$$X_{adj} = \text{X-bar} + r \, (X - \text{X-bar})$$

The level of significance (alpha) for all dependent behavioral variables (.05) was Bonferroni corrected and set at .008 after dividing .05 / 6. The subset of cortisol data was analyzed with an ANCOVA on change scores to assess differences amongst groups. The level of significance (alpha) for all cortisol variables was set at .05.

PROCEDURE

Recruitment

Child participants were actively recruited from March - August 2010. Participation was solicited via a letter to parents of students at Henderson Elementary School located on the Boca Raton Campus of Florida Atlantic University. Approximately 176 letters went out, and 115 were returned granting permission for their children to participate (65%). Once parental consent was received, children were then informed about the study procedures and signed child assent foms as well. Of the initial 115, data from 107 participants was analyzed for all behavior measures and data from 25 participants was analyzed for cortisol concentration levels. Of the remaining eight participants, data for three students was not collected because they were in an individualized education plan for various learning disabilities. Additionally, four students were absent at either pre or posttest time points and so their data was never entered into the database, and the parents of one participant pulled him out of the study after two weeks, without explanation.

Stressor Paradigm Development

Due to the fact that the level of perceived threat a test (stressor) will impose can not only impact test anxiety (Hancock, 2001) but HPA axis activation as well (Dickerson & Kemeny, 2004), the stressor for the current study met very specific criteria. An instruction manual was created for teachers and a reminder list of rules and procedures was sent again 48 hours before classroom visits to ensure guideline

adherence. The fifth grade math teacher created four stressor quizzes (two for each grade) at both pre and posttest. The quizzes were all 10 questions each and the participants scores were calculated as the percentage correct out of 100. The math teacher was instructed to create each quiz one grade beyond each given grade's skill set, so failure would be likely to occur. Administration of the quiz met several of the criteria uncovered in the meta-analyses by Dickerson and Kemeny (2004). Specifically, the quiz was unanticipated to engender an element of surprise and uncontrollability, the importance of the quiz was emphasized by teachers, strict time constraints were imposed, and the students were also informed that their classmates would be grading their papers, to ensure that social evaluative threat was salient. The statistical assessment of this paradigm's difficulty and ability to elicit an HPA reaction can be found in the results section.

MM Intervention Development

Due to the fact that children still are developing and do not have the concentration and attentional skills of adults, it is important that MM techniques be modified in developmentally appropriate ways. For example, Hooker and Fodor (2008) recommend that meditation sessions be shorter in duration for children as compared to adults; it has also been suggested that the use of metaphors be applied when teaching these techniques to children (Thompson & Gauntlett-Gilbert, 2008). Both of these suggestions were taken into consideration during the current study.

A 5-week mindfulness meditation intervention took place, which was administered by the participants' respective teachers. The teacher training and initial information session on mindfulness was taught by Jim Giorgi, M.S. Ed., NCSP, BCIA-

C. Mr. Giorgi graduated from New York University in 1975 with a Bachelor of Arts degree in Psychology, and from Pace University in 1979 with a Master of Science in Education degree in School Psychology. He was ordained as a Dharma Teacher (K. "Bup-Sa") in 2000 and additionally holds a New York State Licensure for Mental Health Counseling (L.M.H.C), amongst his other distinguishable credentials.

During the initial student and teacher mindfulness training session, Mr. Giorgi went over two diagrams depicting the differences between a 'normal' and 'mindful' mind (see Figures 1 and 2), and conducted an open discussion on the meaning of mindfulness. Next, the participants were guided through an actual meditation session. The most basic form of MM involves attending to one's breath and so that was the form of meditation utilized. Student participants were instructed to sit in their desks, keeping their backs as straight as comfortably possible. They then were told to either fold or lay their hands in their laps and to gently close their eyes. As with most beginning meditators, students were instructed to count their breaths as they exhaled, stop at ten, and begin again at one. Participants were instructed to breathe naturally while they kept count. After a few moments they were told to direct their concentration even more so on their breath, actually envisioning the breath going in and out through the center of the chest as their diaphragms rose and fell. Participants were told that distracting thoughts would inevitably pop in their mind, and that they were to acknowledge these thoughts as present then let them go, and bring the focus once again back to the breath. After about 15 minutes, the session ended and Mr. Giorgi took questions. Shortly thereafter the session concluded.
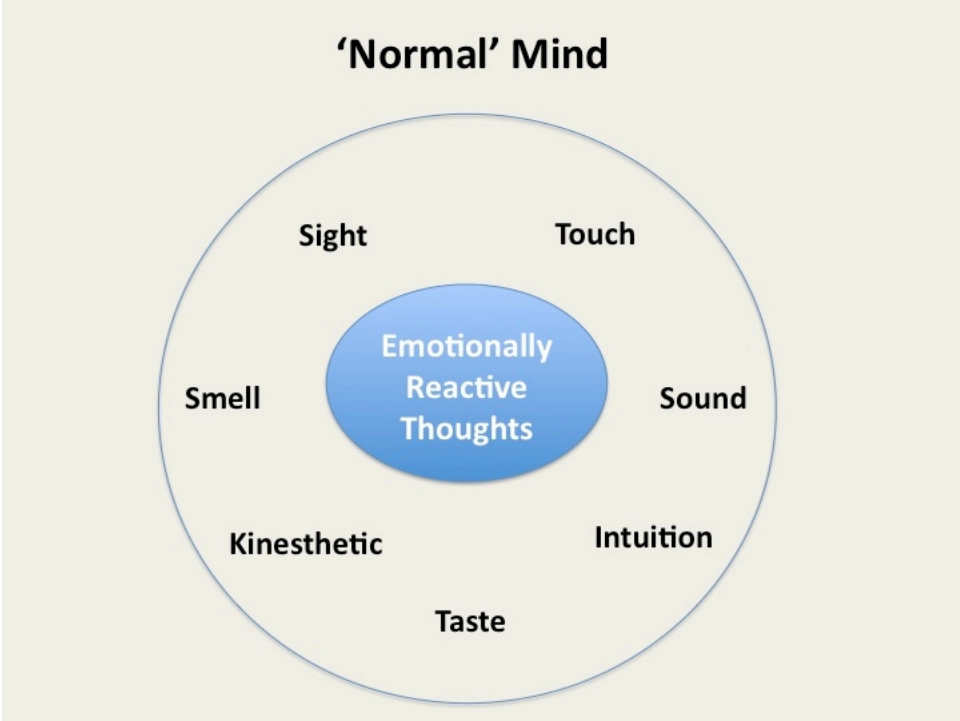
Figure 1. Emotionally Reactive Normal Mind.
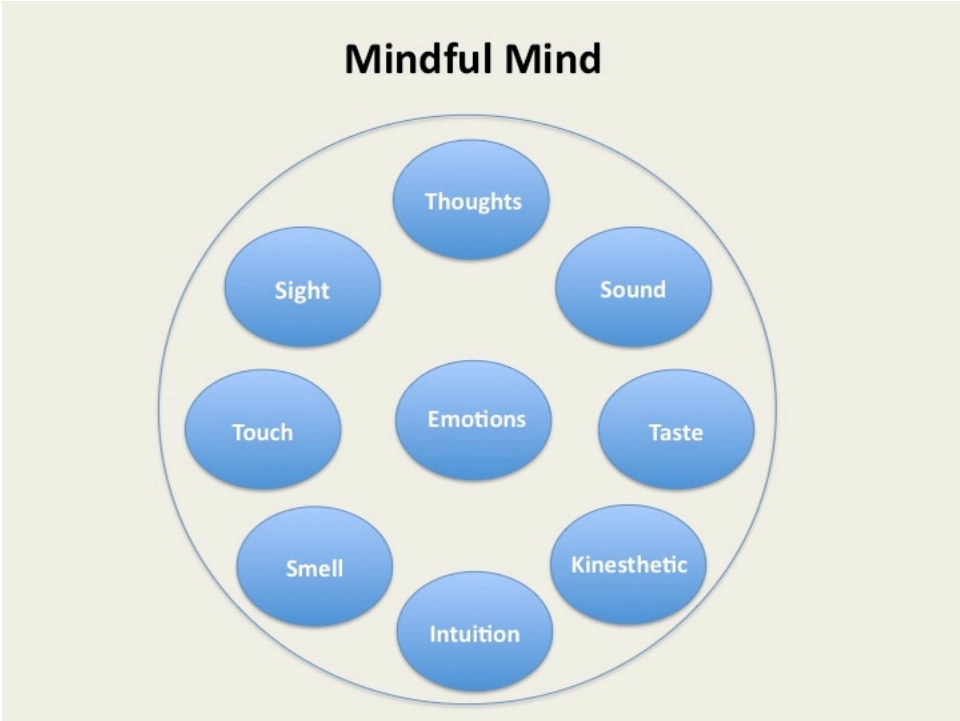
Figure 2. An Aware Mindful Mind.

Data Collection

All data collection procedures took place on the Henderson Elementary School campus. During the first few weeks of the study, basal levels of salivary cortisol were obtained from all subjects and time of day was controlled for. All cortisol measures, therefore, were obtained during a window of time that began no earlier than 1:10 pm and no later that 1:40 pm on any given collection day. During this time, participants were instructed to gently chew on the cotton swab as well as to rest the swab in areas of their mouth where salivary glands are present. A stopwatch was utilized and all participants kept the swab in their mouths for exactly 2 minutes, as it was found that this was a satisfactory amount of time for the cotton rolls to be thoroughly saturated. All samples were collected with the Salivette sampling device (Sarstedt Inc., Rommelsdorf, Germany) and the cotton rolls were pretreated with citric acid in order to facilitate a salivary response from participants. All samples were labeled and frozen within 30 minutes of collection, then stored at -70°C for future assay.

There were two 'stressor' weeks throughout the study in which reactive levels of salivary cortisol were collected within the set standardized time period from participants after they encountered the pop quiz stressor. Reactive cortisol levels were taken approximately 25 minutes after stressor onset commenced. Shortly after the quiz, behavioral measures also were obtained. Saliva samples once again were frozen and stored at -70°C for future assay.

Participants were assigned to groups after the first stressor period based on their classroom subscription. While those in the experimental condition meditated every day in class for approximately 15 minutes, those in the control group were instructed by

their respective teachers to partake in a free reading session of the same duration, which consisted of silent reading of books or other periodicals of the students' choosing. This was chosen as the control condition because it is a form of contemplation, but lacked the breath work and focused concentration needed for a successful MM practice. Both condition assignments lasted for 5 full school weeks.

After the 5th week of the intervention, reactive levels of cortisol once again were collected following the aforementioned procedures. The time window and administration of the 'pop' quiz were held constant, although the post-test pop quiz differed from the pre-test. The samples once again were collected using Salivettes, labeled, and frozen for future assay.

Normalizing the Cortisol Data

Data were assessed and several outliers were identified amongst the cortisol samples. Participants #4 and #7 in the experimental group and #24 and #19 in the control group were given closer examination. The measures of participant #4 and #7 were retained as they had a high basal rate of cortisol as well as reactive cortisol at time 1 and time 2 and, although outliers, neither were identified as 'extreme.'

Participant #19 had an unusually high level of basal cortisol 0.861 (average range for children aged 8-11 years is ND - 0.200 (Salimetrics, PA) and these levels were not sustained in response to the stressor at either time point (0.110, 0.146, respectively). Participant 19's basal cortisol was replaced with the mean for the control group at that time (0.169). Participant # 24 was identified as an extreme outlier and had unusually high reactive levels of cortisol during stressor 1 (1.012), but this reaction was not sustained during stressor 2 nor did they have high basal rates of cortisol. Therefore,

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participant #24's stressor 1 rates of cortisol were replaced with the group mean at that time

(0.262).

RESULTS

Power Analysis

Post-hoc power analyses revealed that the sample size was sufficient for all the behavioral variables, with the exception of the children's color trails test (CCTT), which only achieved a power of .0633, rather than the desired .80 or above. The remaining variables achieved a power of 0.998 or higher. A post-hoc power analysis on the cortisol subset was conducted separately and will be discussed at the end of this section.

Assessing Current Group Differences

Since the current study utilized a quasi-experimental nonequivalent groups design (NEGD), the groups were assessed for pretest group differences using analysis of variance (ANOVAs). The groups differed significantly on several of the behavioral variables, including state and test anxiety, negative affect, and the color trails attention test (see table 1). As aforementioned, reliability adjusted ANCOVAs were conducted to attempt to control for these differences. All but one variable (state anxiety) met the assumptions for ANCOVA. Therefore, an analysis of variance (ANOVA) was

performed on difference scores on the state anxiety measure only.

Behavioral Measures

State and test anxiety. A one-way between groups ANCOVA was conducted to assess the impact of the MMI on both state and test anxiety. The homogeneity of regression slopes assumption for state anxiety was met; however, it failed the

assumption of linearity. In fact, state anxiety and all three of its potential covariates

Table 1

Pretest Group Differences

	Control		Experimental			
Pre-test Measures	M	SD	M	SD	F(1,105)	p
STAIC- State	34.38	7.70	29.66	5.83	12.98	.001*
TAS-C	11.7	8.23	7.84	6.62	7.21	.008*
PANAS-C Positive	53.68	8.73	56.03	9.33	1.73	.191
PANAS-C Negative	28.88	10.22	24.33	9.07	5.87	.017*
CAMM	53.88	7.41	54.52	7.25	.197	.658
CCTT	46.56	10.10	53.74	16.65	6.49	.012*
Pop Quiz #1	30.04	20.03	36.81	16.86	3.56	.062

(i.e. state pretest, Cronbach's alpha adjusted state pretest, and test-retest reliability adjusted state pretest scores) displayed this curvilinear relationship, as detected by scrutinizing a scatterplot. Therefore, an ANOVA on difference scores was conducted on this variable only. The results were not significant, F(1,105) = 1.51, p =. 221, indicating no change in level of reported state anxiety in the MMI group compared to controls at posttest.

The homogeneity of regression slopes assumption for test anxiety and its covariates was met for both the test-retest reliability adjusted scores F(1,103) = .000, p =.984, as well as the Cronbach's alpha reliability adjusted scores F(1,103) = 1.587, p =.211. After adjusting for reliability corrected pre-intervention scores on test anxiety using both reliabilities, the ANCOVA demonstrated that the MMI group was not significantly different in the level of test anxiety, F (1,104) = .033, p = .857 (test-retest), F (1,104) = .033, p = .857 (Cronbach's alpha) at posttest. There was, however, a strong

relationship between post and pre intervention scores, for test anxiety across both

adjusted scores, ηp2 = .548 (see table 2).

Table 2

ANCOVA Results and Descriptive Statistics for Test Anxiety by Study Condition and Pre-
TAS-C Scores

		TAS Score		
	Observed Mean	Adjusted Mean	SD	n
Control	9.11	7.30	6.54	44
MM	5.88	7.15	5.29	63

Source	SS	df	MS	F
Study Condition (SC)	.508	1	.508	.033
TAS. Pretest	1959.97	1	1969.97	126.24**
Error	3844.06	104		

Note. R^2 = .580, Adj. R^2 = .572. **p
=.000

Positive and negative affect. A one-way between groups ANCOVA was

conducted to assess the impact of the MMI on levels of reported affect. The

homogeneity of regression slopes assumption was met for both the positive $F (1,103) =$

.039, p = .844 and negative $F (1,103) = .129$, p = .721 affect variables in that there was

no significant interaction between the covariate and the level of intervention. After

adjusting for reliability corrected pre-intervention scores, the MM group had no

significant differences in the level of reported positive $F (1,104) = .031$ p = .859 or

negative $F (1,104) = .435$, p = .511 emotions compared to controls at posttest. There

was, however, a moderate relationship between post and pre-intervention scores, for

both positive ηp2 =.372 and negative ηp2 = .351 emotions (see tables 3 and 4).

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Table 3

ANCOVA Results and Descriptive Statistics for Positive Affect by Study Condition and Pre-PANAS-C Positive Scores

		PANAS-C (P)		
	Observed Mean	Adjusted Mean	SD	n
Control	55.45	56.84	8.53	44
MM	57.54	56.58	9.59	63
Source	SS	df	MS	F
Study Condition (SC)	1.70	1	1.702	.032
PANAS-C (P) Pretest	3286.73	1	3286.73	61.61**
Error	5547.83	104		

Note. $R^2 = .380$, Adj. $R^2 = .368$.
**p =.000

Table 4

ANCOVA Results and Descriptive Statistics for Negative Affect by Study Condition and Pre-PANAS-C Negative Scores

		PANAS-C (N)		
	Observed Mean	Adjusted Mean	SD	n
Control	25.11	22.85	9.29	44
MM	22.21	23.78	7.42	63
Source	SS	df	MS	F
Study Condition (SC)	19.33	1	19.33	.435
PANAS-C (N) Pretest	2506.92	1	2506.92	56.36**
Error	4625.83	104		

Note. $R^2 = .371$, Adj. $R^2 = .359$.
**p =.000

Mindfulness. A one-way between groups ANCOVA was conducted to assess the impact of the MMI on levels of reported mindfulness. The homogeneity of regression slopes assumption was met, $F(1,103) = .321$ $p = .572$. After adjusting for reliability corrected pre-intervention scores, the MM group had no significant differences in the level of reported Mindfulness, $F(1,104) = .001$, $p = .971$ compared to controls at posttest. There was, however, a moderate relationship between pre and post intervention scores $\eta p2 = .268$ (see table 5).

Table 5

ANCOVA Results and Descriptive Statistics for Mindfulness by Study Condition and Pre-CAMM Scores

		Mindfulness Score		
	Observed Mean	Adjusted Mean	SD	n
Control	54.40	54.91	9.02	44
MM	55.25	54.95	7.33	63
Source	SS	df	MS	F
Study Condition (SC)	.065	1	.065	.001
Mindfulness. Pretest	1828.246	1	1828.246	37.99**
Error	5004.691	104		

Note. $R^2 = .269$, Adj. $R^2 = .255$. **p =.000

Additionally, the relationship between mindfulness (as measured by the CAMM) and the other dependent behavioral variables within both of the respective groups was investigated using a Pearson product-moment correlation coefficient. There was a moderately negative correlation between the mindfulness and state anxiety (STAIC)

variables, r= -.350, n =63, p =. 001. Several significant correlations between

mindfulness and the dependent behavioral variables in the control condition were found

as well. Amongst the control group, there was a moderately positive correlation

between mindfulness and scores on the PANAS-C positive subscale, r= .409, n =44, p

=. 001. Mindfulness also was moderately negatively correlated with state anxiety

(STAI-C), r= -.442, n =44, p =. 001; test anxiety (TAS-C), r= -.531, n =44, p =. 001];

and with scores on the PANAS-C negative subscale, r= -.377, n =44, p =. 001 (see

tables 6 and 7).

Table 6

Pearson Correlation Matrix among Measures (Control)

	PANASN	STAIC	CAMM	PANASP	TASC	CCTT
PANAS-C Neg	--	.524**	-.377*		.492**	
STAIC		--	-.442**	-546**	.366*	
CAMM			--	.409**	-.531**	
PANAS-C Pos				--		-.339*
TAS-C					--	
CCTT						--

Table 7

Pearson Correlation Matrix among Measures (Experimental)

	PANASN	STAIC	CAMM	PANASP	TASC	Quiz
PANAS-C Neg	--	.335**			.339**	
STAIC		--	-.350**	-.443**		-.327**
CAMM			--			
PANAS-C Pos				--		.379**
TAS-C					--	
Quiz						--

Attention. A one-way between groups analysis of covariance (ANCOVA) was conducted to assess the impact of the MMI on attentional skills. The homogeneity of regression assumption was met, $F(1,103) = .441$, $p = .508$. After adjusting for reliability corrected pre-intervention scores, there was no significant difference between the MMI and control groups on post-intervention CCTT scores, $F(1,104) = 3.57$, $p = .061$. There was, however, a small relationship between post and pre-intervention scores, $\eta p2 = .048$ (see table 8).

Table 8

ANCOVA Results and Descriptive Statistics for Sustained Attention by Study Condition and Pre-CCTT Scores

		CCTT Time Score		
	Observed Mean	Adjusted Mean	SD	n
Control	44.84	49.65	13.98	44
MM	44.86	41.50	11.52	63
Source	SS	df	MS	F
Study Condition (SC)	543.93	1	543.93	3.58
CCTT. Pretest	799.86	1	799.86	5.26**
Error	5004.691	104		

Note. $R^2 = .048$ Adj. $R^2 = .030$. **p =.024

Stressor paradigm assessment (behavioral). As previously mentioned the use of a 'pop' quiz paradigm as an example of a 'real world stressor' is novel, so its effectiveness was assessed in two ways. First, the difficulty of the test was scrutinized at both time points, and then it was investigated whether partaking in the quiz resulted in an HPA stress response. As instructed, the pop quiz was designed for failure, and failure in both the fourth and fifth graders took place at pretest. However, although scores for both grade levels still remained in the failure range at posttest, both grades experienced

a substantial increase in quiz scores at posttest. Specifically, analyses using a pair of paired-samples t-tests revealed that the fourth grade did experience a statistically significant increase in average grade, from pre (M = 40.02, SD =17.47) to posttest (M =58.19, SD =16.44), t (35) = -4.289, p = .000 (two tailed). The mean increase in quiz scores was -18.16 with a 95% confidence interval ranging from -26.76 to -9.57. The eta squared of .34 indicated this was a very large effect size. The fifth grade also experienced a statistically significant increase in average grade, from pre (M = 30.98, SD =18.29) to posttest (M =55.69, SD = 20.96), t (70) = -7.600, p = .000 (two tailed). The mean increase in quiz scores was -24.70 with a 95% confidence interval ranging from -26.76 to -9.57. The eta squared of .34 indicated this was a very large effect size.

Additional analyses with paired-samples t-tests showed this quiz score increase for both the MM and control groups, even though grades were mixed in those groups. Specifically, analyses using a pair of paired-samples t-tests revealed that the control group did experience a statistically significant increase in average grade, from pre (M = 30.04, SD =20.03) to posttest (M =57.81, SD =21.66), t (43) = -6.893, p = .000 (two tailed). The mean increase in quiz scores was -27.77 with a 95% confidence interval ranging from -35.89 to -19.65. The eta squared of .52 indicated a very robust effect size. The MM group also experienced a statistically significant increase in average grade, from pre (M = 36.80, SD =16.86) to posttest (M =55.63, SD = 18.00), t (62) = -5.65, p = .000 (two tailed). The mean increase in quiz scores was -18.82 with a 95% confidence interval ranging from -25.49 to -12.17. The eta squared of .34 indicated this was a very large effect size. It is important to note, however, that results of one-way between

groups ANOVAs did not reveal any significant changes between groups at either time point.

Physiological Measures

   Cortisol subset assessment. Due to the fact that cortisol analyses only took place for a subset of participants, it was necessary to ensure the subset (N=25) was truly a representative sample of the larger group (N=107). Therefore, a one-way between-groups Multivariate analysis of variance (MANOVA) was used to investigate if any group differences were present amongst the cortisol sub group and the rest of the data set. The only differences found were on the PANAS-C negative subscale scores at pre-test $F (1,105) = 12.00$, $p = .001$ and posttest $F (1,105) = 5.41$, $p = .022$, as well as scores on the pop quiz paradigm at pre-test $F (1,105) = 6.45$, $p = .013$. None of these differences were anticipated to impact the cortisol data in any way (see tables 9 and 10).

Table 9

Pretest Cortisol Subsample Differences

Pre-test Measures	Cortisol (N=25)		Sample (N=82)			
	M	SD	M	SD	F(1,105)	P
STAIC-State	29.88	3.71	32.13	7.71	1.99	.162
TAS-C	10.20	7.85	9.19	7.47	.339	.562
PANAS-C Positive	57.52	10.63	54.31	8.54	2.39	.125
PANAS-C Negative	20.56	4.32	27.93	10.33	12.00	.001*
CAMM	53.24	8.27	54.57	6.99	.639	.426
CCTT	46.16	12.27	52.20	15.15	3.30	.072
Pop Quiz #1	42.00	16.07	31.59	18.52	6.40	.013*

Table 10

Posttest Cortisol Subsample Differences

Post-test Measures	Cortisol (N=25)		Sample (N=82)		F(1,105)	P
	M	SD	M	SD		
STAIC- State	28.16	3.48	27.84	6.00	.064	.801
TAS-C	6.92	6.62	7.30	5.87	.078	.781
PANAS-C Positive	55.36	8.74	57.08	9.33	.674	.414
PANAS-C Negative	20.08	7.40	24.41	8.37	5.41	.022*
CAMM	53.04	8.06	55.52	7.99	1.84	.177
CCTT	42.47	15.43	45.58	11.50	1.19	.279
Pop Quiz #2	57.20	19.48	56.32	19.65	.038	.846

Stressor paradigm assessment (physiological). The physiological assessment as to the effectiveness of the pop quiz stressor task revealed that the paradigm appears to have been effective in the experimental group at both time 1 and time 2, in that basal rates of cortisol (M =.140, SD = .08) differed significantly from time 1 stressor cortisol levels (M = .304, SD= .20) t(11) = 2.814, p = .017 and time 2 stressor cortisol levels (M = .300, SD = .164), t(11) = -2.939, p =.013. However, the control group did not have the same reaction to the stressor, p >.05.

Due to this differential reaction, pretest stressor rates of cortisol for the MM group (M =. 304, SD = .2 03) and the control group (M =.166, SD =.123) also were significant, t (23) = -2.08, p =.048; however, this change disappeared at posttest, p>.05.

Cortisol. Cortisol measures were analyzed for a subsample of the MM (n=12) and control groups (n=13). Cortisol change scores were created, which entailed

subtracting basal from stressor rates of cortisol for both the control and MM groups. A one-

way between groups ANCOVA then was conducted to assess the impact of the

MMI on reactive levels of salivary cortisol. The homogeneity of regression slopes

assumption was met, $F(1,21) = .191$ $p = .667$. After adjusting for pre-intervention

cortisol change scores, the MM group had no significant differences in levels of reactive

cortisol in response to the stressor, $F(1,22) = .086$, $p = .772$ compared to controls at posttest.

There was however, a moderate relationship between pre and post intervention scores F

$(1,22) = 34.43, p = .000$, $\eta p2 = .610$ (see table 11).

Table 11

ANCOVA Results and Descriptive Statistics for Cortisol Change Scores by Study
Condition and Cortisol Change Scores

		Cortisol Change Score		
		Observed Mean	Adjusted Mean	SD	n
Control		.060	.102	.129	13
MM		44.86	41.50	11.52	12
Source	SS	df	MS	F
Study Condition (SC)	.001	1	.001	.086
Cort Change. Pretest	.360	1	.360	34.34**
Error	5004.691	104		

Note. $R^2 = .647$ Adj. $R^2 = .615$. **p
=.004

Post-hoc power analyses were run to assess effect sizes, as well as establish achieved

and desired power levels. The way in which the data were transformed (e.g. stressor

cortisol concentrations vs. cortisol change concentrations) seemed to impact the effect

size as measured by Cohens d. Although the effect sizes were all moderate to large

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(.620 to .828) as defined by Cohen (1988, 1992), this range impacted the contribution of the

current sample size to achieved power as well as influenced predictions of the

desired sample size needed to raise power. Therefore, the data with the smallest effect size,

and therefore the largest N needed to raise power to .80, is the one presented here (e.g.,

cortisol change concentration 2). To meet the .80 power requirements, a total N of 85, or

43 per group, will be necessary (see table 12). Therefore, definitive

conclusions made cannot be made from this subset of cortisol data.

Table 12

Cortisol Measures and Power Analyses Results

Cortisol Measures	Control		Experimental		t(23)	p	d	Actual Power	Goal Power	Total N Needed
	M	SD	M	SD						
Basal Cortisol	.124	.077	.140	.087	-.499	.623	.194	.075	--	--
Stressor #1 Cortisol	.166	.123	.304	.203	-2.08	.048*	.828	.503	.80	50
Stressor # 2 Cortisol	.184	.129	.300	.164	-1.97	.060	.786	.468	.80	50
Cortisol Difference 1	.041	.147	.164	.201	-1.74	.095	.695	.384	.80	65
Cortisol Difference 2	.059	.129	.159	.188	-1.56	.133	.620	.317	.80	85

DISCUSSION

The current study had hypothesized that several posttest changes would occur in the MM group on the dependent behavioral variables of state and test anxiety, positive and negative affect, attention, and mindfulness itself. Specifically, it was predicted that scores on the state portion of the STAIC, the TAS-C, the PANAS-C negative affect subscale, and the CCTT would all decrease significantly, while scores on the PANAS-C positive subscale and the CAMM were anticipated to increase significantly. After running a series of ANCOVAs on posttest scores, with pretest reliability corrected scores as covariate, it was found that none of the abovementioned hypothesis were supported. However, consistent with the adult literature, it was found that levels of mindfulness, as measured by the CAMM, were correlated with affect and anxiety measures amongst both groups, regardless of which intervention group they were assigned. While most of these results are in striking contrast to those of past studies investigating MMIs in adult populations, the construct of mindfulness and its established positive correlation to measures of well-being and negative correlations with anxiety and negative affect measures were consistent.

It has been said that the skill of attention is one of the most highly impacted by MM practices (Davidson & Goleman, 1977); however, the current results did not support this notion. The CCTT encompasses several of the skills that theoretically can be impacted by contempletative practices such as MM. For example, the CCTT measures the rapidity of participants' scanning ability, their eye-hand coordination,

mental flexibility, and speed of information processing. Further, the CCTT requires its participants to utilize sustained visual attention, all while retaining the proper sequencing pattern (Llorente et al.,2003). The time component of the test was what was analyzed here, and it appears that while the control groups CCTT scores remained stable from pre to posttest, the experimental group had extremely high pretest time scores that regressed toward the mean at posttest. In short, although some have found a sustained attention superiority amongst mindfulness meditators when compared to controls (Valentine & Sweet, 1999), these results were not found with the CCTT time scores in the current study.

Some authors have proposed that attentional components are tied to and catalyze other skills, such as emotional and self regulation from early on in childhood (Stansbury & Gunnar, 1994), and that developing attentional skills can result in improvements in these other domains later in life (Feltman, Robinson, & Ode, 2009). However, the hypotheses that the MMI would impact affect was also not supported. This could be for the simple reason that some of the MMIs that have successfully impacted positive affect are extremely short in duration and the affective appraisals of emotional stimuli are measured immediately follow the practice of MM (Erisman & Roemer, 2010; Arch & Craske, 2006). It remains unclear whether the affective shifts that took place could sustain a length of time any longer than the ephemeral state mindfulness that appears to have been measured. Perhaps if the participants in the current study were instructed to meditate just prior to the stressor and/or utilize their breathing exercises during the stressor, affect outcomes would have been significant between the two groups. However, that raises the question that if measures need to immediately follow a

mindfulness practice, or a participant needs to be reminded to 'tap' into their mindful mind, then how truly mindful are they?

Another possibility that could have contributed to the lack in findings in regard to affect could involve the known ties between affect and attention. In novice meditators, it is known that the development of concentrative skills comes first, and then other attention-based skills such as emotional regulation follow (Valentine & Sweet, 1999). Perhaps, due to the duration of the current intervention and its inability to engender even concentrative skills as measured by the CCTT, the attentional awareness necessary for emotional and self-regulation did not have sufficient time to burgeon.

The hypotheses in regard to state and text anxiety also did not receive support. This is counter to a study conducted with adults, which utilized the trait portion of the STAI and found a significant difference in the reporting of anxiety from the meditation group when compared to controls at posttest (Davidson et al., 2003). These finding are counter to that of Napoli et al. (2005), who found reductions in test anxiety after a MMI. However, their study did not test for pre-group equivalence and the participants were assigned to groups as classroom entities, not a true random assignment. Therefore, their results, as illustrated by a series of t-tests on difference scores, must be interpreted with some caution.

Additionally, although it has been established that MM and other techniques that incorporate mindfulness have a moderate effect as interventions for anxiety and depression (see Hofman, Sawyer, Witt, & Oh, 2010 for meta-analysis), what remains to be seen is whether these techniques are able to cause consistent significant reductions in this symptomology in non-clinical cases across studies. Additionally, it is possible that

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MM works so well in clinical populations simply due to the nature of the participant's levels of anxiety and/or depression. Perhaps moderate or high levels of these afflictions can be attenuated down into more normal ranges through a MMI, but when they are already near or within normal range, there may be little to no room for improvement; or the measures used were not sensitive enough to capture subtle improvements that may have taken place.

Most surprisingly, the hypothesis that MM would impact in the MM group also was not supported. Mindfulness is not simply a form of meditation, but is the construct that is cultivated through this form of meditation itself. Therefore, it seemed plausible that those exposed to the MMI would have had an increase in their scores on self-reported mindfulness; however, scores at posttest were not significantly different amongst the control and MM groups. Since past studies have established mindfulness has strong positive relationships with measures of well-being and strong negative relationships with measures of distress (see Grossman et al., 2004 for meta-analysis), the current study explored similar correlations as well. Current results were in accordance with those from the abovementioned meta-analyses of adult studies. Interestingly, mindfulness was significantly correlated with more of these variables within the control group than the MM group. This could be because these correlative relationships are established under the bounds of a more dispositional or trait mindfulness, rather than a state that can be altered easily.

To complicate matters slightly, a formal distinction between trait (dispositional) mindfulness and state mindfulness has been made in the literature, with the former predicting self-directed behaviors in daily life, and the latter related to transitory shifts

in affect and experience (Brown & Ryan, 2003). These correlative results, then, call into question the conundrum of what is truly being measured here: is mindfulness a fleeting state of mind or is it a dispositional mental trait (Brown & Ryan, 2003) that is possibly the result of a bidirectional gene environment interaction (Davidson, 2010)? The results of this current study may cause one to lean toward the latter, as mindfulness scores measured by the CAMM were stable over the study duration across all groups. This also suggests that this particular MMI fell short of creating significant changes due to possible flaws in the intervention itself (discussed in limitations), or that the changes needed to alter dispositional mindfulness cannot be had over a short course of treatment.

The limited significant outcome of the current MMI could have occurred for many other reasons that may include both individual differences and sample characteristics. It is possible that meditation may be too taxing for school age children to practice everyday; for some, being forced to sit still might create a disinterest in participating. Kaiser-Greenland (2010) pointed out that some children are simply able to meditate whereas others are not, and this is dependent on the child's abilities to direct and maintain control of their attention. In her book, she puts forth a comprehensive mindfulness-training program, which involves interactive exercises using child-friendly analogies and group activities as well as quiet focus on the breath. Perhaps an intervention that conceptually helps children better understand what mindfulness is, coupled with its practice, will help achieve an effective outcome. Since it has been established that the benefits of mindfulness can be achieved through means other than meditation, it would make sense to include these in MMIs as well as traditional meditation. For example, dialectic behavioral therapy (DBT) (Linehan, 1993) and

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acceptance and commitment therapy (ACT) (Hayes, et al., 1999) are two mindfulness interventions that focus more heavily on teaching the non-meditative components of mindfulness, and which have had much success.

The lack of findings also might have been due, in part, to the age of the participants. It is important to note that there is some disagreement as to whether children may benefit from MMIs due to the age of the participant possibly confounding the success of the outcome. Therefore, some researchers claim that it is best to wait until children are in Piaget's stage of formal operations (at approximately age 12) before they can learn these methods (Wagner, Rathus, & Miller, 2006), while others believe that those in the concrete operations stage (at approximately age 7-12) can benefit from mindfulness techniques as well (Verduyn, 2000).

Other factors impacting the intervention outcome surround the intensity and duration of the MMI itself. Only a small amount of time was allotted by the school for the initial MM training conducted by Mr. Giorgi to take place, and perhaps this wasn't enough to firmly instill the principals of mindfulness that are necessary to propel the practice. It also wasn't feasible to have a professional meditation instructor in the classroom every day, so the teachers, who were novices themselves, acted as the instructors. Although this paradigm was successful in research involving EEG asymmetry and mindfulness (Jones et al., 2011), the current intervention was only about half of the 10 weeks used in the aforementioned study. Perhaps if the current MMI were longer, substantial differences between the control and experimental conditions would have been achieved.

Additionally, it was investigated whether a pop quiz paradigm was a sufficient HPA trigger and whether stress reactions could be attenuated at posttest by partaking in the MMI. Due to the size of the subsample and the differential reactions from the experimental and control groups, it is not possible to draw definitive conclusions about either at this time. Cortisol has been put forth as a feasible and objective measure of improvement in mindfulness-based stress reduction programs (Matousek et al., 2010). Thus, theoretically, the current MMI should have resulted in a decrease in salivary cortisol in the MM versus the control group. This prediction was based, however, on increases in self-reported mindfulness, which did not occur. Therefore, it was not surprising that the physiological changes did not take place as well. Contemplative practices such as yoga, meditation, and deep breathing exercises all have been shown to lower both basal and reactive cortisol levels, although the study paradigms have been disproportionately in favor of studying non-reactive cortisol levels (see Matousek et al., 2010 for review).

Knowing the damaging effects of inappropriate reactions to stressors, the attenuation of the physiological stress response would seem to be of interest to researchers. However, the current study illustrates that perhaps until more is known about the particular environmental dynamics that lead to cortisol release, the internal dynamics of differing stress perceptions, and how MM truly impacts the brain, studies will be plagued with confounds and inconsistencies. For example, although stressor paradigms do exist that engender cortisol release, they are not always consistent in developmental studies (Gunnar et al., 2009). Further, since the physiological response to stress occurs even if there is the perception of a threat to homeostasis (Folkman &

Lazarus, 1988), subjectivity in stress perception plays a key role in stress reaction. Some even go on to argue that these individual differences in the stress response are what should be anticipated in cortisol research (Granger, Stansbury, & Henker, 1994; Gunnar, Sebanc, Tout, Donzella, & van Dulmen, 2003; van Goozen, Fairchild, Snoek, & Harold, 2007). Although several studies have attempted to 'control' for these differing reactions by dividing groups into high stress and low stress responders during analyses (Kirschbaum et al., 1995; Kunz-Ebrecht, Kirschbaum, Marmot, & Steptoe, 2004; Roelofs, Bakvis, Hermans, van Pelt, & van Honk, 2007), the limited cortisol sample size of the current study did not allow for that possibility and attempting to divide participants based on behavioral measures yielded no distinct groups. However, it is hopeful that once the full sample of cortisol is analyzed from all participants, distinct groups will emerge from the data set, allowing for more solid conclusions to be made.

Limitations

Due to the nature of the stressor as well as the intervention, the classroom setting was the only plausible place for the current study to occur; yet this paradoxically imposed a number of limitations. Time constraints and class access on data collection days were an issue and might have caused students to rush through their self-reported behavioral measures. Additionally, the way in which the desks were set up also allowed for no privacy during self-report, and for some measures (e.g STAIC and PANAS-C) this might have caused a level of discomfort during response.

The fact that true random assignment could not be implemented in the current study design resulted in several pretest group differences, which ultimately could have

impacted results. Although these differences were statistically controlled for as much as possible, there is no simple solution for resolving pretest differences in NEGDs. As was mentioned in the results section, the experimental group had a significantly different reactive cortisol level than the controls. Even though this difference was no longer significant once basal were levels subtracted from each of the respective groups and assessed on levels of change only, a larger sample might be able to uncover if, in fact, these differences between groups would have been sustained.

Additionally, another major confound that could have impacted cortisol results was that all participants seemed to do better on the posttest quiz than on pretest. Two things could have taken place here: selection-maturation, whereby certain individuals in the respective groups matured more than others over the course of the study, or the second quiz simply was insufficiently designed. Either way, the quiz at posttest may have seemed less threatening, which is key to activating the HPA stress response. Therefore, trying to ascertain if this response could be attenuated by the MMI posed even more of a challenge, as it appears the stressor was not consistent. In addition, intervention length also was a limitation that has been alluded to several times throughout this discussion and could have led to the null results between groups on both the behavioral and physiological measures. In fact, one study that utilized a shortened MBSR by just two weeks was not successful in achieving any reductions in participant's cortisol levels (Klatt, Buckworth, & Malarkey, 2009); whereas other meditation studies measuring cortisol levels have found significant reductions (Jevning, Wilson, & Davidson, 1978; Maclean et al., 1994).

Future Directions

The null results of this study speak to the need for control groups as part of pretest / posttest designs applied to MMIs. If the current study lacked a control comparison group, it would have appeared that there were several improvements on the dependent behavioral variables, which, in actuality, statistically did not exist. Results such as these call into question some of the methodologies utilized in past studies that lacked these controls, yet reported positive outcomes of MMIs (see Baer, 2003 for review). The addition of control comparison groups should be a staple in future projects in order to draw the proper conclusions about the benefits of MMIs.

Individual differences also must be taken into account in future studies. Therefore, variables ranging from temperament to personality must be considered as potential moderators of the stress response, as well as what their relationship may be with levels of trait mindfulness. In addition, individual differences must be examined when creating and implementing potential MMIs. Since not everyone responds the same way to stressors, participants may not respond the same to practices that induce relaxing effects as well. Additionally, the claims as to what MM is capable of impacting run vast and, at first glance, it appears that mindfulness may have the makings of a panacea. However, special attention must be given to confounding factors impacting each study, and generalizations to the population must be done so with some caution. Although participant subjectivity always will play a role in study outcomes such as this, more rigorous methods for studying MMIs must continue to be developed.

Lastly, work must be done toward uncovering what specific techniques yield successful results in cultivating a more mindful mind within child populations. Since

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the developing brain is in a constant flux, it is necessary to take into account where children are developmentally to create age specific MMIs. Since sustained attention is both a necessary perquisite for MM practice, as well as a component impacted by it, daily practice durations need to be age appropriately standardized. As aforementioned, sometimes children have yet to develop the attentional skills necessary to embrace these techniques initially. There is some evidence 'less is more,' as some have achieved significant results with models requiring as little as 1-5 minutes of practice per day (Semple et al., 2006; Wagner et al., 2006).

In addition to duration, other avenues of cultivating mindfulness besides strict meditative practices should be considered when working with children. Instead of having children sit quietly for a specific duration with little to no variety in their daily practice, more interactive paradigms that would allow children to interact with each other, ask questions, and use imagery, might instill a better definition of what type of mind state they are trying to achieve. Finding the right combination may take some time, but it will be necessary to create and test a standardized MMI in the future to buttress research findings.

To conclude, the empirical investigation of mindfulness is still in somewhat of a nascent stage and like any topic has its challenges. Researchers still are uncovering what the construct of mindfulness truly is, while simultaneously attempting to study its effects on human behavior, brain functioning, and physiology. The sometimes-mixed results to date are a forewarning that the future of mindfulness research must include more thorough and standardized methodology. Only then can mindfulness be given the acclaim, or skepticism, it truly deserves.

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