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LOYOLA UNIVERSITY CHICAGO

MINDFULNESS AND EXECUTIVE FUNCTION: EXAMINING THE IMPACT OF THE MINDUP CURRICULUM ON FIRST GRADERS' EXECUTIVE FUNCTIONING

A DOCTORAL RESEARCH PROJECT SUBMITTED TO

THE FACULTY OF THE GRADUATE SCHOOL OF EDUCATION

IN CANDIDACY FOR THE DEGREE OF

DOCTOR OF EDUCATION

PROGRAM IN SCHOOL PSYCHOLOGY

BY

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CHICAGO, ILLINOIS

MAY 2016

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ABSTRACT

The effectiveness of the MindUp Curriculum in improving the executive function of first grade children was evaluated by a pre-/post-intervention study. The MindUp Curriculum focuses on teaching children to self-regulate their behavior and mindfully engage in focused concentration. MindUp aims to develop perspective taking skills, empathy, kindness, and complex problem solving skills in children. Participants were from two separate first grade parochial school classrooms. The children (n=34; 17 students per classroom) were rated on their overall executive function skills using a standardized rating scale of executive function, as well as nine separate constructs that comprise executive function. The Comprehensive Executive Function Inventory was used to assess the children's executive function. In addition to a Full Scale score, the CEFI assesses the following nine constructs that comprise executive function: attention, emotion regulation, flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and working memory. The MindUp curriculum was not found to have a significant impact on the participants' executive function abilities as measured on a standardized rating scale. Regardless, the current project highlights several important factors related to mindfulness and executive function, as well as limitations that may have negatively impacted the findings.

CHAPTER I

INTRODUCTION

This doctoral research project focuses on whether or not children's executive function improves following an intervention using mindfulness-based technique. We will begin with an introduction and definition of executive function (EF). When considering what executive function (EF) is (or is not), it is important to understand that there is no single definition that is commonly accepted in the scientific literature. Many researchers have offered definitions, models, and hypotheses about this topic; some quite simplistic, others extremely detailed and multi-faceted. Those will be discussed below. Information regarding the prevalence of EF will be provided, as well as a review of school-based interventions for EF that has been implemented in the past. Following our discussion of EF, we will provide definitions for mindfulness as well as research regarding the use of mindfulness practices and their impacts on children's functioning in multiple domains of development.

CHAPTER II

REVIEW OF LITERATURE

Definitions and Models of EF

Many different cognitive functions are classified as "executive", but all of these processes overlap and are highly interdependent. Thus, theoretical models are required not only to understand the concept, but also to guide the work of practitioners so that they can utilize best practices in their selection of assessment tools, interpretation of test performance and everyday behavior, and understand executive function development (Anderson, 2002; Garon, Bryson, & Smith, 2008). As mentioned above, there are many different definitions and proposed models of executive function; however, none have been universally adopted. We will review an assemblage of these; however, this is in no way a comprehensive review of all proposed research and models of EF. To further illustrate this point, Goldstein and colleagues identified over 30 different definitions of EF that were present in the scientific literature (Goldstein, Naglieri, Princiotta & Otero, 2013). A selection of these definitions and models are reviewed briefly below in chronological fashion, and span over 40 years of time. We have chosen to focus on researchers that are familiar with school psychologists; however, this list is in no way exhaustive. Although the construct of EF has evolved over time, it is also apparent that the core ideas of what truly comprise it have generally remained the same.

Baddeley and Hitch (1974) were perhaps one of the first to discuss the concept of EF through their central executive system. This system coordinates information processing through two subsystems, referred to as the phonological loop and the visual-spatial sketchpad. Welsh and Pennington (1988) defined executive function in a more simple fashion, and referred to it as the ability to maintain appropriate problem-solving sets to attain future goals. Gioia, Isquith, Guy, and Kenworthy (1996) described executive functions in a more complex manner, and defined it as processes responsible for guiding, directing, and managing cognitive, emotional, and behavioral functions. These processes also typically required novel problem solving abilities. Delis, Kaplan, and Kramer (2001) defined executive function as multiple cognitive constructs, including problem-solving, concept formation, abstract thinking, creativity, planning, flexibility, inhibition and impulse control. Koziol and Budding (2009) have a model that implicates how subcortical regions of the brain, such as the basal ganglia and cerebellum, impact executive function. Their model is based on the premise that various deficits in working memory result in varying cognitive implications, such as planning or being able to maintain a mindset of goal-directed behavior. These types of weaknesses have far reaching consequences with higher cognitive functioning abilities that require the integration of multiple constructs of EF, such as having the ability to organize thoughts, perceptions, or behaviors to perform more complex, higher-order cognitive tasks. Lezak, Howieson, Bigler, and Tranel (2012) described EF as being comprised of four parts: (a) volition; (b) planning; (c) purposive action; and (d) effective performance. Each of these four parts is associated with a distinct set of behaviors. The associated behaviors are

needed for the execution of socially appropriate behaviors. Diamond (2012) provides a broad definition of EF that is based on the neural circuitry of the prefrontal cortex. According to her model, there are three core components of EF—inhibition, working memory, and cognitive flexibility. These act as a base that allow for the development of higher-order, complex EF constructs such as reasoning, planning, and problem solving. Perhaps the most complex model of EF is that of McCloskey and colleagues (McCloskey & Perkins, 2013; McCloskey, Van Divner & Perkins, 2009). This theory includes over thirty different constructs that could be considered executive functions. His theory is based on the following operational definition which is comprised of the following six interrelated concepts:

1. Executive functions are multiple in nature; they do not represent a single, unitary trait;
2. Executive functions are directive in nature, that is, they are mental constructs that are responsible for cueing and directing the use of other mental constructs;
3. Executive functions cue and direct mental functioning differentially within four broad construct domains: perception, emotion, cognition, and action;
4. Executive functions use can vary greatly across four arenas of involvement: intrapersonal, interpersonal, environment, and symbol system use;
5. Executive functions begin development very early in childhood and continue to develop at least into the third decade of life and most likely throughout the life span, and

6. The use of executive functions is reflected in the activation of neural networks within various areas of the frontal lobes.

In an attempt to synthesize this broad array of definitions over forty decades of research, Goldstein et al. (2013) defined executive function as an umbrella term that encompasses many different abilities that are mediated by prefrontal areas of the frontal lobes. For the purpose of this doctoral research project, we choose to use their definition of EF, which is as follows: *Executive function (EF) is a term that refers to a variety of cognitive processes largely mediated by the pre-frontal areas of the frontal lobes and encompasses both cognitive and affective constructs, including planning, working memory, attention, inhibition, self-monitoring, self-regulation and initiation* (Goldstein et al., 2013).

EF and Developmental Trajectories

Although definitions of executive function vary widely in scope, there are many common threads woven throughout them all. One shared theme is that executive function follows a developmental trajectory, beginning in infancy. As children grow, several critical periods exist throughout early childhood, adolescence, and young adulthood. Hunter, Edidin, and Hinkle (2012) have provided a comprehensive illustration of the development of executive function skills over time, which also takes into consideration the potential impact that developmental disabilities and psychopathology may have on the development trajectory of EF. During infancy and the preschool years, attention, impulse control and self-regulation, and working memory abilities are the primary EFs developed. Problem-solving skills also begin to emerge, and inhibition, shifting, and

cognitive flexibility are also present. The primary influence on development is based on interactions with caregivers and the environment, which become more complex as children grow due to developing language and social skills. An interesting study of EF in infants was conducted by Kovács and Mehler (2009). They studied infants at the age of seven months who were exposed to bilingual input from both parents. Each parent spoke one language exclusively. Their work suggested that these children exhibited more advanced executive function than peers exposed to only one language; however, their findings were only specific to inhibition, shifting, and cognitive flexibility.

During early childhood, improvements in inhibition, working memory, verbal fluency, and planning abilities occur. Further refinement of these skills helps to prepare preschoolers for advanced academic tasks and active learning. Educators expect children to be successful when increased demands are placed upon them. In order for this to occur, children need to engage in appropriate behavior, problem-solve, work well with other children, and follow directions from adults (Tarullo, Milner, & Gunmar, 2011). When we take this into consideration, it makes sense that a large component of early childhood curricula focus on establishing classroom routines and teaching expected school behavior.

During middle childhood, increased processing speed, verbal fluency, shifting, and planning abilities become more advanced. Brocki and colleagues have suggested that inhibition is fully developed in children between the ages of 10 to 12 years (Brocki & Bohlin, 2004; Brocki, Fan, & Fossella, 2008). During this time period, educators expect children to engage in the appropriate behavior and academic expectations of the school

environment. The focus of the classroom is shifted to mastering academic content. To achieve academic success, children must be able to integrate their EF skills with increased academic demands.

By adolescence, it is assumed that children have developed the executive function skills necessary to successfully navigate the school environment. What tends to occur; however, is inconsistency in demonstrating these skills or generalizing them across contexts. Research on inhibitory control (Leon-Carrion, Garcia-Orza, & Perez-Santamaria, 2004; Luna, Garver, Urban, Lazar, & Sweeney, 2004), processing speed (Luna et al., 2004), and working memory and decision-making (Luciana, Conklin, Cooper, & Yarger, 2005; Hooper, Luciana, Conklin, & Yarger, 2004) have shown that these skills continue to develop throughout adolescence. Anderson, Anderson, Northam, Jacobs, and Catroppa (2001) examined how adolescents between the ages of 11 to 17 years old performed on a variety of executive function tasks. Their findings demonstrated improvement in some areas (selective attention, working memory and problem solving) but not all constructs that were assessed were impacted. It is believed that performance on tasks requiring multiple aspects of EF are linked to the neurobiological processes of pruning and myelination in the frontal cortex that occur during adolescence (Blakemore & Choudhoury, 2006). Therefore, it is hypothesized that various EF constructs likely follow different developmental trajectories.

Many researchers believe that EF skills are not fully developed until young adulthood. This theory is supported from a neurobiological perspective, which is illustrated by continued white matter development due to myelination that occurs through

the third decade of life (Sowell, Thompson, Tessner, & Toga, 2001). Working memory, cognitive flexibility, planning, and problem-solving all reach their peak during adolescence (Huizinga, Dolan, & van der Moelen, 2006). It is during young adulthood that people are able to most effectively problem-solve and efficiently perform known tasks in an automatic fashion. During this critical period, individuals build upon previously learned EF skills. Society expects that by this time, young adults have built a repertoire of executive function skills that enable them to function independently and effectively within their environment, as well as engage in good decision-making skills and self-monitoring of behavior (Otero & Barker, 2013).

Cognitive and Affective Components of EF

Cognitive executive functions include problem solving, planning, and working memory and are primarily mediated by the dorsolateral prefrontal cortex (Damasio, 1996). The prefrontal cortex has also been intimately linked to specific executive function deficits, such as planning, problem-solving, decision-making, and shifting (Siddiqui, Chatterjee, Kumar, Siddiqui, & Goyal, 2008). Affective executive functions include emotional regulation and inhibitory control. These constructs are mediated by the orbitofrontal and anterior cingulate/medial circuits and are responsible for linking cognition and emotion (Fuster, 1997, 2001). The orbitofrontal cortex is part of a frontostriatal circuit that has strong connections to the amygdala and other parts of the limbic system (Chudasama & Robbins, 2006), which aides in the integration of affective and cognitive information, and for the regulation of motivated and goal-oriented behavior (Rolls, 2004). Research on the affective components of EF is somewhat limited compared

to the more expansive literature on the cognitive constructs that comprise EF (Damasio, Anderson, & Tranell, 2011). This may in part be due to the fact that the affective constructs are more difficult to measure using standardized assessment tools currently available. (Otero & Barker, 2013)

Prevalence of Executive Dysfunction in Children

Very limited research has been conducted regarding the prevalence of EF disorders in non-clinical populations of children. Most studies have focused on children with psychiatric illnesses or disorders, such as ADHD, Austism Spectrum Disorder, Epilepsy, FAS, Schizophrenia, etc. Although the majority of these research studies utilized a control group of sorts, it is difficult to generalize findings across the various studies. This can be attributed to the following confounding factors: differing inclusionary criteria for participation in the studies, the varying definition of EF and its constructs, and the differences in the samples in terms of gender, age, socioeconomic status, location, parental education levels, etc. Existing literature indicates that EF deficits underlie most psychiatric disorders in children and adolescents. Unfortunately, there are various constructs that comprise EF, and each one is linked to different activities and brain circuitry. This makes it difficult to associate specific constructs as potential markers for individual disorders (Hosenbocus & Chahal, 2012).

Lambek, Tannock, Dalsgaard, Trillingsgaard, Damm, and Thomsen (2011) studied Danish children aged 7 to 14 years old with and without ADHD. Their findings indicated that 83% ($n = 40$) of the children in the clinical sample and 49% ($n = 92$) of non-clinical children were impaired on one or more tasks measuring EF. When looking

at children impaired on two or more tasks, 60% of clinical children and 15% of non-clinical children were considered to have EF deficits. When utilizing other statistical analysis methodology, 10% of non-clinical children were found to have EF deficits. Roy et al. (2010) studied executive dysfunction in French children aged 7-12 years old with neurofibromatosis type 1. Their findings indicated that children with NF1 performed more poorly than the healthy children in the control group on all planning tasks.

School-Based Interventions for EF

Success in various aspects of life is highly dependent on having intact executive functioning abilities, especially within the educational environment (Alloway & Alloway, 2010). Executive function deficits in childhood have been shown to have a negative impact on academic, social-emotional, and adaptive functioning later in life, and are present at all stages of development in children both with and without neurodevelopmental disorders. We will provide summaries of some relevant findings throughout this section of our review of the literature. Research by Locascio, Mahone, Eason, and Cutting (2010) found that reading comprehension difficulties were associated with executive dysfunction; specifically, poor strategic planning/organizing. These findings have direct implications for educational programming and intervention selection for both the general education and special education populations within school systems; however, the research base for executive function interventions with children and adolescents is somewhat limited (Otero, Barker, & Naglieri, 2014). What is apparent is that schools are currently struggling with how to appropriately intervene with students with executive function deficits. Several studies have provided insight into how school-

based interventions have impacted EF. A child's ability to self-regulate is essential for academic success. For instance, self-regulation skills are embedded in an array of activities that students must engage in to be successful in a classroom setting including the ability to sit still, follow directions, and concentrate during instruction and control impulses (Caughy, Mills, Owen & Hurst, 2013). So, given the myriad of EF deficits that exist among all populations of school-aged children, educators need to begin developing and identifying research-based interventions that target both global and narrow aspects of EF (Riccio & Gomes, 2013). Flook et al. (2010) examined the effects of mindfulness awareness projects in second and third grade students and found a strong effect for children with executive function difficulties, and children who began the intervention with poor executive function as measured by parent and teacher rating scales showed improvements in behavioral regulation, metacognition, and overall global executive control, and these results generalized across settings. The authors indicated that children who were less regulated showed greater improvement in executive function compared to controls. This supports the current literature, as summarized by Diamond (2012), in that those with the greatest deficits tend to benefit the most. Caughy, Mills, Owen, and Hurst (2013) concur that self-regulation is a critical component of school readiness. Thus, improving self-regulation skills is a viable approach for reducing ethnic disparities in early academic achievement. In a recent study, Caughy and colleagues examined emerging self-regulation skills in a sample of 407 Black/African American and Latino preschoolers from low socio-economical backgrounds. After facilitating a battery of self-regulation tasks with the preschoolers, this study found "robust ethnic differences in self-

regulation skills." One of the most interesting findings of this study was that in early childhood, Latino children excelled at inhibitory control and working memory tasks while Black/African American children excelled in complex response inhibition and set shifting tasks. Furthermore, the study found that both inhibition control and cognitive flexibility were significantly underdeveloped in the children from the sample compared to previous studies which sampled predominantly affluent White, non-Hispanic children. Nonetheless, given the myriad of EF deficits that exist among all populations of school-aged children, educators need to begin developing and identifying research-based interventions that target both global and narrow aspects of EF (Riccio & Gomes, 2013). Research with minority populations is also needed.

Several factors must be considered before an intervention to target executive function deficits is selected within the school setting. The first thing to consider is the child's age and current level of developmental functioning. Executive function and a child's brain both follow a developmental trajectory that parallel each other, with notable critical periods from infancy to young adulthood (Otero, Barker, & Naglieri, 2014). Research has also supported the notion that certain EF interventions work better for certain age groups (Diamond & Lee, 2011). Diamond (2012) outlines six general principles regarding executive function training that must be considered when selecting interventions for children:

- Those who most need improvement benefit the most;
- Transfer effects from EF training are narrow;

- EFs should be challenged throughout training (i.e., demands must continue to increase to see effects);
- Repeated practice is key;
- Whether EF gains are produced depends on how an activity is done;
- Outcome measures must test the limits of the children's EF abilities to see a benefit from training.

The use of psychopharmacological drugs or neurofeedback as an intervention approach is not a viable alternative in the schools as these treatments are outside of the scope of the local education agency as they are deemed to be medical in nature and must be initiated by a parent or physician. Other options; however, are more reasonable for school-based practices. These options are briefly summarized below.

Computerized Training Programs

Computerized approaches are currently one of the prominent modalities for EF intervention. Computerized training of EF typically targets working memory and/or attention, although certain approaches have also attempted to address deficits in inhibition, albeit, with less success (Thorell, Lindqvist, Bergman Nutley, Bohlin, & Klingberg, 2009). Computerized programs use repeated practice and reinforcement in *attempts* to produce structural changes in the brain thus improving working memory/EF (Klingberg et al., 2005). In 2013, Melby-Lervag and Hulme conducted a meta-analysis of computerized working memory training programs, and concluded that there is no convincing evidence of the generalization of efficacy to other cognitive constructs, including nonverbal and verbal ability, inhibitory processes in attention, or academic

functioning (reading decoding or arithmetic). These results imply that computerized working memory training programs appear to produce short-term, specific training effects at best that do not generalize amongst the various cognitive constructs that are classified as EF nor are effects sustained on long-term follow-up measures. Computerized approaches also present a significant financial consideration, which is an important factor that schools must take into account when making decisions to select interventions and programs that can be used with a large population of students. These approaches rely heavily on technology, requiring computers or tablets, and typically require licenses that are sold per student.

Strategy Instruction

Luke (2006) defines strategy instruction as a student centered approach that supplies struggling learners with tools and techniques to understand and learn new material or skills. A key component of strategy instruction is that it allows for the direct and immediate application to practice the material or skill in various areas of school and life. Meltzer, Pollica, and Barzillai, (2007) have pointed out that interventions to address EF deficits within the classroom should include direct instruction of metacognitive strategies and that strategy instruction must be linked to the curriculum and taught in a structured, systematic way. Traditionally, older children and adolescents benefit more from strategy instruction than younger children (Young & Amarasinghe, 2010).

Curricula

The vast majority of the scientific literature describing the effects of school curricula targeting EF deficits has focused on the early childhood population and place an

emphasis on developing inhibitory skills. Tools of the Mind and the Montessori approach are considered stand-alone approaches, while Promoting Alternative Thinking Strategies (PATHS) and the Chicago School Readiness Project (CSRP) are considered supplementary add-ons to existing curricula. Diamond and colleagues have written substantially on these programs, and readers are referred to their work (Diamond, 2012; Diamond, Barnett, Thomas, & Munro, 2007; Diamond & Lee, 2011) for a comprehensive review.

Only one curriculum to target EF skills across the entire K-12 spectrum currently exists. The Educational Services Department of the Rush NeuroBehavioral Center (RNBC) developed an Executive Functions (EF) Curriculum series (Bozeday, Gidaspow, Minton, & Smith, 2010) which consists of a Primary Curriculum (K-2), an Intermediate Curriculum (3-5), a Middle School Curriculum (6-8) and a High School Curriculum (9-12). Their approach utilizes a research-based framework combined with a classroom-based orientation. The RNBC Executive Functions Program identifies the following EF constructs as important for classroom instruction: self-regulation, self-awareness, goal-directed behavior, self-monitoring, and flexibility to solve problems and revise plans.

Leon (2008) conducted an independent evaluation of the RNBC Executive Functions Program while it was implemented in four Chicago Public Schools. Findings from this review indicated that students who performed well in the Executive Function Program had a higher rate of homework completion and earned higher grades in math and reading. Furthermore, the curriculum also appeared to have an impact on standardized assessments; outcome data demonstrated that students using the curriculum in the fall

demonstrated higher spring scores on the Reading First and ISAT reading exams. Finally, students, families, and school personnel were reportedly pleased with the curriculum, and students exhibited strong buy-in as demonstrated by their adherence to the program, across ages and schools.

Games

Traditional childhood games can also help improve executive functions in children are easy to implement in the school setting, particularly during physical education classes or recess. These informal EF interventions are best suited for preschool and early elementary aged students. Yeager and Yeager (2013) describe how games such as *Mother May I?; Simon Says; Red Light, Green Light, Freeze Tag; and Statues* help aid in the development of working memory and response inhibition. The development of EF through shared activities with peers is an enjoyable, low cost way for students and schools to aid in the development of EF.

Definitions of Mindfulness

Within the scientific literature, multiple definitions of mindfulness abound. The concept of mindfulness has been in existence for over a century. The initial translation of the Buddhist terms *sati* (Pali) or *smrti* (Sanskrit) into what we now refer to as '"mindfulness' is believed to have been conducted by T.W. Rhys Davids in 1881. Since that time, many authors, including the initial translator, have attempted to define just what is meant by the term mindfulness. The original definitions that were proposed were typically based on readings and interpretations of ancient Buddhist texts. In the mid 20th century, the shift in definitions became more informed by actual mediation practices

(Gethin, 2011). Bishop et al. (2004) proposed a two-component operational definition of mindfulness, which involves the self-regulation of attention in conjunction with the adoption of a particular orientation toward one's experiences in the present moment. According to Weare (2014), "mindfulness is essentially about learning to pay attention and cultivate attitudes such as kindness, curiosity, and non-judgmentalism" (p. 1038). However, mindfulness is not synonymous with attention or meditation (Felver, Doerner, Jones, Kaye, & Merrell, 2013). Felver et al. proposes that mindfulness moves beyond existing attentional and self-regulation models and focuses on an inherent attitude of openness and acknowledgement of the reality of one's present internal (e.g., cognitions, emotions) and external (e.g., sensory stimuli) experience.

Mindfulness-Based Interventions

Mindfulness and physical activities that can positively impact EFs in children include meditation, martial arts, yoga, and aerobics. These activities require repetition and continued practice to gain maximum benefits (Diamond, 2012). Weare's (2013) meta-analysis of over 20 studies which examined mindfulness practices with youth begins to explore the foundation for empirical evidence in this area. Although the use of mindfulness practices with this population is still emerging, these approaches are appealing to both school personnel and students because of the potential for positive outcomes. Benefits include improved mental health and well-being, mood, self-esteem, self-regulation, positive behavior and academic learning (Weare, 2013). According to Felver et al. (2013), mindfulness therapies can be implemented as direct interventions tailored to the specific needs of the school and its students. For instance, mindfulness

therapies could be utilized as (a) a Tier 1 intervention infused into an existing social-emotional learning curriculum or as a standalone universal and preventative approach delivered to the entire student body, (b) a Tier 2 intervention delivered in small groups as targeted support for specific students, and/or (c) a Tier 3 intervention for individual students needing more intensive and targeted support.

Patterns of stress-response are fostered from birth and throughout one's life based upon continued exposure, experiences and interactions with the environment (Napoli, Krech & Holley, 2012). Recent studies show that children are under enormous stress and pressure from home and school, which may result in psychological distress similar to adults (Napoli et al., 2012). Thus, teaching mindfulness training may be especially important for children surrounded by familial and/or environmental stress such as crime-ridden neighborhoods, abandoned and dilapidated housing, and inadequate resources to meet basic needs. These assertions were tested in Napoli and colleagues examination of the effects of a 24-week mindfulness training on the attention and concentration skills of 228 first, second and third grade students in a southwestern city in the United States. The intervention incorporated physical, sensory, social and cognitive activities aimed at a comprehensive experience for the students. Napoli et al. asserts breathing "regulate[s] the autonomic nervous system, focus[s] the mind and increase[s] self awareness" (p. 101). Thus, mindfulness techniques such as attention to breathing can teach children how to attend and focus as well as how to manage stress and anxiety at an early age.

According to Weare (2014), most teachers aspire for their students to develop higher-order thinking and behaving skills such as a sense of curiosity, resiliency, and

effective problem solving skills, creativity, discernment, and overall sound character. With this goal in mind, mindfulness training has the potential to make positive impacts in schools, to foster skills essential for academic success, and to help teachers reach core intentions. Practicing mindfulness activities can have positive impacts on both physical and mental health (Davidson et al., 2003).

Short et al. (2007) used fMRI to study the effects of extensive meditation training, and found heightened activation patterns in executive attention networks. These findings correlated with improvements in sustained attention as well as with error monitoring, thus promoting higher-order cognitive processing. Zeidan, Johnson, Diamond, David, and Goolkasian (2010) found that brief meditation training provided over four days to a sample of college students resulted in reduced fatigue, anxiety, and increased mindfulness; participants also exhibited significantly improved visual-spatial processing, working memory, and executive functioning abilities.

Lakes and Hoyt (2004) implemented a three-month school-based Tae Kwon Do intervention using the Leadership Education Through Athletic Development (LEAD) curriculum to evaluate cognitive, affective, and physical self-regulatory behaviors in students in grades K-5. The LEAD curriculum also incrementally increases the level of challenge and reward as participants achieve higher levels of competence, a necessary component of EF training (Diamond, 2012). Results of this study indicated that students participating in the martial arts group demonstrated greater improvements in areas of cognitive and affective self-regulation, pro-social behavior, classroom conduct, and performance on a mental math test.

Gothe, Pontifex, Hillman, and McAuley (2012) studied college females who participated in yoga and aerobics, and found that the women demonstrated shorter reaction times and increased accuracy on inhibition and working memory tasks following yoga practice. Although their study did not find significant improvement of EFs following aerobic exercise, other research has demonstrated effectiveness in this area. Verbaugh, Konigs, Scherder, and Oosterlaan (2013) conducted a meta-analysis on the effects of physical exercise on executive functions in preadolescent children, adolescents, and young adults and found that acute physical exercise (such as aerobics) enhanced executive functioning, regardless of age group. Davis et al. (2007) examined how aerobic exercise impacted executive function in overweight children 7 to 9 years old. This study found that the Planning scores on the *Cognitive Assessment System* (CAS) were significantly greater for the group of children who participated in the high-dosage aerobics condition. This finding suggests that exercise could be a simple way to enhance cognitive functioning; it also encourages good physical health habits in children. This finding has important implications for academic performance as well, as the Planning scale of the CAS has been linked to academic achievement in previous empirical studies (Naglieri & Rojhan, 2004). Diamond (2012) has also suggested that exercise alone may be less effective in improving children's EFs than activities that combined exercise and other mindfulness activities, such as martial arts or yoga.

Research with adults has shown positive effects for improvements in executive functioning and learning and preliminary research with children show similar effects (Weare, 2014). For example, Gould, Dariotis, Mendelson, and Greenberg (2012)

randomly assigned 97 fourth and fifth graders from an urban public school into a 12-week school-based mindfulness program using secular yoga. Gould and colleagues focused on the effects of yoga-inspired mindfulness training on gender, grade-level and symptoms of depression. Although the intervention did not significantly reduce depressive symptoms, findings indicated that the intervention successfully lessened involuntary problematic responses to social stress such as rumination, intrusive thoughts and emotional arousal.

In regards to its effectiveness, research with adults indicates that mindfulness improves sustained attention, visual-spatial memory, working memory and concentration (Weare, 2014). And, "although mindfulness-based intervention with children and adolescents is still an emerging area of research, data to date support the effectiveness of this modality" (Felver et al., 2013).

Opposing Research About Mindfulness

Mindfulness refers to a heighten state of awareness which is characterized by the self-regulation of attention and concentration towards present-moment experiences. Mindfulness-based interventions are typically delivered in a group setting as brief interventions (e.g., 8-12 sessions) focused on mindfulness meditation practices and principles (Strauss, Cavanagh, Oliver, & Pettman, 2014). Although mindfulness-based interventions are a growing trend, its efficacy has yielded mixed reviews. Opponents argue that the effectiveness of mindfulness practices and principles with children are limited at best. And, some argue that its effectiveness with children has not yet been substantiated. A meta-analyses of mindfulness-based interventions concluded that some

research supporting the effectiveness of mindfulness interventions were limited in methodology including lack of rigor and failure to provide robust comparisons to control conditions (Strauss et al., 2014). Another central flaw in mindfulness studies include the use of self-report behavior rating scales, which are designed to measure clinical change, being used with non-clinical participants (Rempel, 2012). Some findings have also provided overly broad inclusion criteria such as embodying interventions not grounded in mindfulness (Strauss et al., 2014). Although there is growing interest in mindfulness-based interventions with children in schools, there are few controlled studies and very few studies using mindfulness as a universal intervention (Kuyken et al., 2013). The body of evidence for using mindfulness-based interventions with children is growing but still preliminary in its findings. Overall, the results are promising but not proof.

In summary, the research base for EF and mindfulness interventions in schools is in its infancy compared to the wealth of literature that exists to address other problems, such as reading. Schools must consider financial constraints when selecting interventions, which can put constraints on what is feasible. Strategy instruction and mind/body approaches are both interventions that can be implemented in the school setting at little to no cost. Physical activities are highly appealing, especially considering the high rates of obesity and other health-related concerns many children exhibit. Mind/body activities can also help reduce stress in students. Computerized training and curricular approaches have also been found effective with certain groups of children with EF deficits; however, typically require the school to adopt these approaches in one way or another.

Furthermore, there is also a concern with resources since both of these approaches require a significant financial investment.

CHAPTER III

METHODOLOGY

Sample and Procedures

The sample consisted of 52 minority children (29 boys and 23 girls) from two separate first grade classrooms at two parochial schools in Chicago, Illinois. The sample was diverse in terms of the children's ethnic backgrounds (60% African American, 36% Hispanic, 4% Biracial). Socioeconomic status was primarily low income as measured by eligibility for federal free and reduced lunch programs. The first class (n = 20) had 89% of students eligible for free and reduced lunch, and the second class had 100% of students eligible for free and reduced lunch. The first class consisted of a total of 20 students (8 girls and 12 boys), of which the racial breakdown was 90% Hispanic and 10% Biracial. The second class (n = 32) was comprised of 21 girls and 11 boys, of which the racial breakdown was 97% African American and 3% Biracial. None of the students in either sample had any known disabilities or medical diagnoses. Specifically, none of the students have been identified as being eligible for special education services nor have they received any clinical diagnoses of Learning Disabilities, Autism or Attention-Deficit/Hyperactivity Disorder (ADHD). Additionally, none of the students presented with significant behavioral issues.

To recruit for the study, parents of the identified 52 students were invited to a parent meeting. The parent meeting was held 1-2 weeks prior to the initiation of the

study, and was facilitated by the researchers. There was one meeting held at each school during evening hours to accommodate working families. Both meetings focused on defining the purpose and procedures of the research project, and fostering informed consent. Parents were asked to read and sign a consent document (see Appendix I) to enroll their student in the study. In an introductory session, researchers explained the intervention to the students using age and developmentally appropriate language. The researchers will ensure assent from each student participant in addition to the signed parental informed consent (see Appendix II). Parents and teachers of participating students completed a standardized executive function rating scale (i.e., Comprehensive Executive Function Inventory) at baseline and upon completion of the implementation of the curriculum.

At inception, the investigators sent home letters inviting parents to the parent meeting. Consent forms as well as baseline Parent Forms of the CEFI were administered the week of the parent meetings. The Loyola University Chicago Institutional Review Board first approved all documents sent to parents. Classroom teachers completed the Teacher Forms of the CEFI upon the investigators receipt of signed consent forms and prior to the intervention implementation (baseline). Both parents and teachers were asked to complete CEFI rating scales upon completion of the 15-week curriculum. Doctoral students in school psychology implemented the curriculum in each classroom. To promote the integrity and fidelity of the intervention implementation, the doctoral students participated in a 90-minute training focused on the uniformity of the

implementation. Lessons were implemented following the same schedule and accounted for holidays and/or other weeks off per school calendars.

Curriculum

The *MindUP Curriculum: Brain Focused Strategies for Learning – and Living* (MindUP) is a research-based training program comprised of 15 lessons based on principles of neuroscience. Students who participate in the program learn to self-regulate their behavior and mindfully engage in focused concentration, two skills that are required for academic success. MindUP lessons align with state standards, including the Common Core, as well as the Marzano Framework for dynamic educators. The curriculum also allows for improved academic performance while helping students develop perspective taking skills, empathy, kindness, and complex problem solving skills. The Collaborative for Academic, Social, and Emotional Learning (CASEL), based in Chicago, has thoroughly researched and accredited MindUp, and their findings have indicated that students who participate in MindUP experience reduced stress, improved academic performance, and stronger concentration.

In addition to the many benefits to children mentioned above, teachers and families also report benefits. The Hawn Foundation indicated that teachers who implemented the MindUP curriculum have experienced the following benefits:

- Help kids maintain focused attention
- Form more accurate perceptions of students
- Think more clearly especially under pressure
- Improve communication with students, parents and staff

- Improve the overall classroom climate by infusing it with optimism and hope
- Helps to create a stronger, more vibrant school culture
- Feel happier, more joyful and grateful — a disposition that ultimately spills out of the classroom and into private life
- Experience greater job satisfaction.

The MindUp curriculum provides step-by-step instructions that facilitate student inquiry, exploration, discussion, reflection and insight into individual behaviors and experiences. Each lesson includes a section on "***Linking to Brain Research***," details on how to "***Clarify to the Class***," the goal of the lesson, materials needed for implementation, a warm-up activity, insight into how to lead the lesson, and ideas for generalizing learning objectives. Although MindUp is a social-emotional curriculum, each lesson provided ideas for integrating the concepts into other academic areas such as Science, Math, Language Arts, Social Studies and Physical Education. The introduction to each lesson identifies and explains the subject, outlines the goals and objectives, and includes personal testimonies of the programs efficacy. Next, the lesson explains how each lesson relates to neuroscience and guidelines from making the concepts of brain research more relatable and developmentally appropriate for the students. The warm-up activities introduce the topic and clarify the learning goals. ***Leading the Lesson*** entails creating concrete connections between learning objectives, activities and practical scenarios. Lastly, the Connecting to Curriculum section of each lesson offers suggestions for expanding the lesson to other content areas. The MindUp PK to 2nd grade curriculum

consists of fifteen lessons divided into four units: Let's Get Focused, Paying Attention to our Senses, It's all about Attitude, and Taking Action Mindfully.

The unit entitled, ***Let's Get Focused*** embodies the initial three lessons. ***Let's Get Focused*** provides an introduction to how the brain works; an operational definition for mindful attention, and an overview of the importance of mindful attention. Across the initial three lessons, students were provided definitions and nicknames for core brain functions. Specifically, the prefrontal context (PFC), which is responsible for regulating thoughts, was nicknamed the ***Wise Old Leader***. The PFC allows individuals to plan ahead and create strategies for long-term and short-term decision-making. The prefrontal cortex is also a key feature for one's ability to adjust actions and reactions in various situations. Next, the amygdala, an important part of the limbic system responsible for regulating emotions, emotional behavior and motivation, was referred to as the ***Security Guard***. And, lastly, the hippocampus, which is associated mainly with long-term memory, was lovingly referred to as one's ***Scrapbook***. As a result, students learned to understand the function and location (basic brain anatomy) of the scrapbook, wise old leader and the security guard.

Unit II isolates each of the five senses into six individual lessons in a module entitled, ***Sharpening Your Senses***. Students are asked to listen, see, smell, taste and feel in a state of heightened attention and alertness. Activities included guessing items from a sound, taste, touch, smell or minor visual details. The three lessons in Unit III, entitled ***It's All About Attitude***, focuses on perspective taking and choosing optimism. Activities included providing students with scenarios and helping them to explore alternatives for

responding mindfully to practical instances of peer conflict or school-related difficulties. The final unit, ***Taking Action Mindfully***, examines pro-social skills such as gratitude, kindness and being mindful in one's community. Activities focused on generalizing learning concepts to everyday applications. Students were asked to explore situations with kindness and gratitude being the prevalent behavioral response.

Materials needed for the intervention implementation often consisted of photocopies copies of the worksheets from the manual and writing utensils. With exception to the mindful feeling and tasting activities, most other materials could be found in a typical school setting (e.g., bell for chimes, bags for holding/hiding items, index cards for labels). Materials used for mindful tasting included sweet, sour and salty foods. And, materials of varying texture (e.g., smooth, soft, rough) were used for mindful feeling (e.g., cotton balls).

Outcome Measures

The use of a standardized assessment of executive function was the primary data collection tool. To measure a child's executive functioning before and after the intervention, the *Comprehensive Executive Function Inventory* (CEFI) was completed by both the parent and teacher of each participant. The CEFI is a rating scale designed to measure behaviors that are associated with executive function in children and youths aged 5 through 18 years old. A parent, teacher, or the child (12 years and older) can complete the rating scale. In addition to a Full Scale score, the CEFI assesses the following nine constructs that comprise executive function: attention, emotion regulation,

flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and working memory.

Executive function strengths and weaknesses can also be determined within the various constructs. The CEFI parent and teacher rating forms are both Likert-scale forms that include 100 questions about a child's level of executive functioning. Group data will be analyzed as well as individual children's scores at the onset and completion of the intervention. The form is available in both English and Spanish, and can be read to a respondent if reading level is a concern, although the authors purport a fifth grade reading level for the items and a seventh grade reading level is needed for the instructions.

CEFI reports can be obtained through the MHS Online Assessment Center. The online scoring allows for all statistical calculations to be computed through the program, thus reducing error and allowing for a more efficient analysis and comparison of data. There are three report types provided for the CEFI, all of which will be used at various points throughout the evaluation. The reporting options allow the evaluator to select the desired level of significance (i.e., $p<0.01$ or 0.05) and confidence interval (i.e., 90% or 95%). For the purpose of the current study, the strongest statistical data is desired, so a significance level of $p<0.01$ will be used in conjunction with a 95% confidence level on all reports obtained. The three report types are summarized below:

1. *The Interpretive Report*: provides information about a single administration.
2. *The Progress Monitoring and Treatment Effectiveness Report*: combines the results from up to four ratings by the same rater to examine changes in behavior that may have occurred over time.

3. *The Comparative Report*: provides a multi-rater perspective by combining results from up to five different raters.

The MHS Online Assessment Center offers many benefits including the option of double-entry of responses to verify data entry accuracy, immediate generation of reports once responses are entered, reports that can be printed or saved in various formats (i.e., pdf or rtf files), and it can be accessed at any computer with internet access.

The CEFI has strong psychometric qualities with excellent internal reliability on both the total score (.97 or higher) and on the individual scales. The stability of the ratings between pre-test and post-test is also important in considering the research design of the evaluation. In the normative sample, CEFI scores had excellent stability, and differences fell within one standard deviation across administrations, making this a reliable tool to use. Content validity is also strong, as the authors conducted a comprehensive review of current theory and research literature, and also have clinical and research experience directly related to the conceptualization and assessment of executive function. Construct validity included exploratory factor analysis and congruence analysis. In the normative sample, a single, unidimensional factor structure was found for all three forms of the CEFI, and was very consistent across genders, age groups, race/ethnicities, and clinical/educational statuses. This indicates that the CEFI is an appropriate tool to use to answer the primary research question as the CEFI total score can be used to determine a child's global level of executive function. Criterion-related validity of the CEFI was evaluated using univariate analyses of variance (ANOVA) to examine mean differences between the general population and samples of children previously diagnosed with

specific clinical disorders or identified as having a learning disorder. Correlations of CEFI scores with scores from other measures (i.e., Behavior Rating Inventory of Executive Function) were also used to evaluate the validity of scoring and interpretation methods. Overall results from the analyses indicate strong evidence for the criterion-related validity of the CEFI as well as being sensitive to differences in behaviors between the general population, clinical groups and educational groups.

Results from the CEFI can be used to inform decision-making when evaluating the effectiveness of a particular individual or group intervention. When used in a clinical setting, CEFI results can be collected at the beginning of an intervention and at several points throughout the intervention in order to evaluate whether a particular program is associated with behavioral improvement. In research studies, group data can be analyzed to determine whether change between administrations is significant, and the results can be used to support the continuation of a particular intervention or program. The CEFI is ideal for the evaluation of a group intervention for the following reasons:

1. The scales were carefully developed to measure a broad continuum of behaviors typically associated with executive function.
2. The scores derived from the scales are generated upon a nationally representative normative sample made up of a diverse group of individuals.
3. The CEFI has strong psychometric qualities.
4. The use of standard scores allows comparison to other psychometric instruments.

Implementation

Paired Sample: Classroom One

In the first classroom, implementation began in the middle of February and concluded the last week of school, which was the first week of June. Of the 20 students in the class, 19 students participated in the intervention from start to finish. The lesson was delivered weekly on Fridays, immediately following lunch and recess. Implementation lasted approximately thirty minutes per session. Sessions were conducted every week, with the exception of two weeks when there was no school on Friday. On those two occasions, lessons were administered the following Monday, resulting in two sessions occurring in one week. Lessons were taught in sequential order as presented in the manual. Attendance was consistent for the students. There was a substitute teacher present during one week of the intervention; however, this did not have an impact on the implementation of the session. Students were polite and respectful to the interventionist during the sessions. They were engaged and excited to participate. The teacher reported that the children looked forward to the lesson each week and shared with her how much they enjoyed each weeks sessions. The parent and teacher pre-intervention CEFI rating scales were completed during the two weeks prior to the initiation of the intervention and were returned to the interventionist at the first week of implementation in February. Initial parent rating scales were sent home with the consent forms for participation and were returned to school with their children. The classroom teacher collected all of the forms and then provided them to the researcher, along with her teacher rating scales during the first week of the intervention. The post-intervention CEFI rating scales were

sent home the second to last week of the intervention (Friday following the lesson) and were completed during the final week of the intervention. Ratings were returned to the teacher on the last day of the intervention and were returned to the researcher the following week after school had ended (second week of June).

Behavior problems were not a concern in the first classroom. The classroom teacher was present during the intervention and assisted the interventionist with behavior management. No extreme behaviors were reported. Some students required reminders to be quiet (when talking to a peer for example) or needed redirection to the task (if they became distracted). Overall, behavior was compliant and did not have a negative impact on the implementation of the intervention.

Paired Sample: Classroom Two

In the second classroom, implementation began in the middle of February and concluded the last week of school. All 32 students participated in a 30 minute lesson once a week on Friday immediately following lunch and recess. Sessions were conducted consecutively with the exception of two Fridays with no student attendance (i.e., spring break and a teacher professional development day). As a result, the missed sessions were made-up on the following Mondays resulting in two sessions in a week on two occasions. Nonetheless, the lessons were taught in sequential order. Student attendance was consistent. Students were actively engaged and receptive to the weekly lesson. Upon arrival each week, the facilitator was welcomed with a choral greeting, "Good afternoon...God Bless you!" At the onset of the intervention (end of February), the first grade teacher was planning to leave on sabbatical to the Philippines. The regular teacher

would leave in early March and not be present for the remainder of the school year. Consequently, the teacher's aide took on the additional role and responsibilities, and provided the academic instruction and classroom structure from March to June. Teacher rating forms of the CEFI were provided to the regular teacher and the principal before the sabbatical. However, despite several requests, the CEFIs were not completed by the regular teacher before her departure. "I don't have time," was the rationale provided. In the absence of the regular teacher, teacher rating scales of the CEFI were provided to the teacher's aide to no avail. The teacher's aide took no onus of the task and presented with little to no buy-in during implementation. For example, the teacher's aide took no interest and no active role in the intervention implementation. She did not use or attempt to generalize the learning concepts outside of the intervention time, and assisted nominally with efforts to retrieve parent rating scales. Thus, no pre- or post-intervention data was able to be collected from the teachers.

For parents, CEFIs were collected the first two weeks on implementation and again the last two weeks of implementation. The parent rating scales were sent home in student's book bags. Telephone calls and principal support were used to collect post-intervention CEFIs from the parents. Out of the 32 students, only 17 complete sets of parent rating forms were able to be retrieved; pre- and post-intervention CEFIs were collected for 12 girls and 5 boys (n = 17). Ninety-four percent of the sample was Black/African American and less than 1% (0.06%) was Bi-racial. None of the students had any known disabilities or medical diagnoses. However, one male student was in the

process of being referred for a full individualized evaluation for poor academics and problematic behavior (e.g., opposition, impulsivity, restlessness, academic avoidance).

Although students actively engaged and seemed to look forward to the weekly interaction, the loss of the regular teacher and persistent class management issues were mitigating factors. The intervention took place just after lunch. Students typically transitioned in from recess as the weekly lesson began. It was not unusual for the students to need multiple prompts for classroom expectations. Students needed encouragement to go directly to their seats and to refrain from off-task talking. The classroom discipline was often loud, punitive and negative. Yelling, harsh verbal reprimanding and threats of loss of privileges or phone calls home were common discipline tactics. As a result, the facilitator often used increased levels of praise and acknowledgement throughout the intervention. During implementation, attention seeking behaviors were often present. For example, students often raised their hands to respond to group probes despite not having a response for the specific question. Students would plea and pout to be called upon. If the facilitator sat at any point during implementation, students would begin scooting their chairs inward and/or racing to sit next to the facilitator often invading body space and creating disorder which needed redirecting. The students were slow to respond to prompts and seemed conditioned to respond to yelling and punitive practices. Without soliciting, the teacher's aide often overshadowed the intervention implementation to scold individual students or the whole class for making poor choices. Thirty-two first graders in one classroom make for very noisy, busy and congested quarters. Thus, the intervention activities were often conducted while students attended from their

individually assigned desks. Activities that required sitting or lying on the floor took careful orchestration.

Statistical Methods

Statistical analysis was used to analyze the quantitative data (i.e., standard scores) obtained from the MHS Online Assessment Center. Although statistical analysis procedures may be scientifically complex, this provided the strongest interpretation of the data. Statistical analysis allowed for comparison to other measures as well as within and between groups included in the sample, and lended greater credibility to the intervention in general. Advanced statistical analysis procedures can also provide information related to the complex relationships among variables that may not otherwise be possible and increase the usefulness of the study's findings. The use of the MHS Online Assessment Center allowed for preliminary scoring and to identify executive function strengths and weaknesses after entering raw scores from the rating scales at both baseline and post-intervention. Pre-test scores for both samples were compared to post-test scores using the statistical analysis from the detailed CEFI scoring report and a Tukey-Kramer Multiple Comparisons Test. The original methodology of the current investigation planned to compare pre-/post-data using the statistical software SPSS, version 22 (IBM Corp., 2013). A multivariate analysis of covariance (i.e., MANCOVA) was going to be performed with baseline and post-intervention scores for the Full Scale CEFI scores as well as all nine executive function constructs (i.e., attention, emotion regulation, flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and

working memory) as outcome variables. MANCOVAs were going to be specified separately for teacher and parent reports.

Standard scores were compared for pre- and post-test data for advanced statistical analysis. The Tukey-Kramer Multiple Comparison test is a single-step procedure for multiple comparison and statistical analysis. This method compares all possible pairs of means, and is based on a studentized range distribution (q). The Tukey-Kramer method compares the means of every treatment to the means of every other treatment and identifies any difference between the two means that is greater than the expected standard error; the method is conservative when dealing with unequal sample sizes. When doing pairwise comparisons, this method is considered the best available when confidence intervals are needed or sample sizes are not equal.

To answer the first research question, whether or not MindUP has an impact on children's general executive functioning abilities, the CEFI Full Scale (i.e., total) score was used as an indicator. The MHS Online Assessment System was used to analyze the pre- and post-CEFI Full Scale scores. A paired sample t-test was then conducted to determine if change occurred, and if so, if it was significant. More specifically, the paired sample t-test was conducted to determine whether there was a significant difference between the average values of the same measurement (i.e., pre- and post-CEFI Full Scale scores) made under different conditions (i.e., baseline and post-intervention). Significance was determined at the $p < 0.05$ level using a 95% confidence interval. The computerized calculation allowed for the determination of significance in the CEFI Progress Monitoring and Treatment Effectiveness Report.

To answer the second research question, whether certain constructs of executive function are more impacted than others following participation in the MindUP Curriculum, statistical analyses (i.e., Tukey-Kramer Multiple Comparisons Test) were conducted to identify the constructs most impacted across the population. Thus, the rate of growth or regression was calculated to determine if the change in performance represented a significant improvement or decline for each construct for all participants. Once constructs were identified as significant across the sample, further interpretation was conducted based on other variables that may have impacted outcomes.

CHAPTER IV

RESULTS

The data collected from Classroom One included both parent and teacher pre- and post-behavior rating scales (i.e., CEFI) for 17 students. This represents three less students than originally expected. One student in the classroom did not attend school regularly, and only participated in one session of the intervention, so his results were omitted. Two other students did not return a parent rating scale at the culmination of the intervention, so their results were also omitted. Out of the original 32 participants in Classroom Two, only 17 parent rating scales were returned. Group data analysis of the entire sample (Classroom One and Two) was comprised of 34 parent ratings (17 from each school) and 17 teacher ratings (Classroom One). There were approximately 12 weeks between pre- and post-data collection for both samples. Pre-test scores for both samples were compared to post-test scores using the statistical analysis from the detailed CEFI scoring report (obtained from the MHS Online Assessment Center), a paired sample t-test and a Tukey-Kramer Multiple Comparisons Test.

A statistical analysis was conducted to analyze the quantitative data obtained from the MHS Online Assessment Center for each completed rating scale. The computerized scoring of the CEFI yields a progress monitoring and treatment effectiveness report for each participant. The report provides an evaluation of the ratings per participant from across the two administrations (i.e., pre- and post-parent rating scales, pre- and post-

teacher rating scales). The ratings explore for consistency, omissions as well as overly negative or positive impressions. In addition to providing standard scores, a 95% confidence interval and EF strengths and weaknesses, the CEFI also examines the statistically significant ($p < .05$) differences between scores. The scores on the CEFI are reported as standard scores. The following qualitative descriptors can be used to describe the scores:

Table 1

Qualitative Descriptors

Scores	**Descriptor**
69 or below	Well Below Average
70-79	Below Average
80-89	Low Average
90-109	Average
110-119	High Average
120-129	Superior
130 and above	Very Superior

Data: Classroom One

Two of the significant differences on the CEFI resulted in scores that went from Average to High Average. The third significant difference was a pre-intervention score that was Low Average and improved to a High Average score at post-intervention. The two students that experienced significant declines in their scores were in the Average range at both pre- and post-intervention. The mean pre-test score for the 17 teacher rating

scales was a standard score of 96 (range = 79 – 111 = 32) and the post-test average standard score was 94 (range = 82 – 106 = 24); a decrease of 2 points. More specifically, for the teacher scales, there was not a significant difference, $t(16) = 1.58$, $p = 0.13$.

The mean of the pre-intervention CEFI Total Score for the Teacher Rating Scales was a standard score of 96, with a standard deviation of 10. The mean of the post-intervention CEFI Total Score for the Teacher Rating Scales was 94, with a standard deviation of 7. The correlation between groups was 0.826. The effect size (dz) was 0.346 which is between small and medium by Cohen's standards. The power was found to be 0.269. This can be attributed to the relatively small sample size, as it is common knowledge that increasing the sample size increases the power of a statistical test.

The mean of the pre-intervention CEFI Total Score for the Parent Rating Scales was a standard score of 103, with a standard deviation of 16. The mean of the post-intervention CEFI Total Score was 104, with a standard deviation of 15. The correlation between groups was 0.853. The effect size (dz) was 0.118, which is small by Cohen's standards. The power was found to be 0.074. This can be attributed to the small sample size, as it is common knowledge that increasing the sample size increases the power of a statistical test.

Data: Classroom Two

No statistically significant changes were found for Classroom Two between the pre- and post-parent CEFI ratings. The mean of the pre-intervention CEFI Total Score for the Parent Rating Scales was a standard score of 95, with a standard deviation of 8. The mean of the post-intervention CEFI Total Score was 97, with a standard deviation of 9.

The correlation between groups was 0.977. The effect size (dz) was 0.963, which is large by Cohen's standards. The power was found to be 0.961.

Group Data Analysis

The MHS Assessment data for the group resulted in a total of 34 parent ratings. Based on the pre-intervention CEFI Total Scores, no students were classified as being in the Well Below Average range. One student was classified as Below Average, seven students were classified as Low Average, 21 students were classified as Average, two students were within the High range, two students were considered Superior, and one student was considered Very Superior. The post-intervention CEFI Total Scores also did not result in any Well Below Average scores. Eight students were classified as Low Average, 20 were considered Average, three were classified as High Average, two were considered Superior and one was considered Very Superior. Five students experienced a change in scores that were considered significant; three were improvements and two were lower scores from the pre-intervention administration. All five significant changes occurred in Classroom One; no significant changes were reported for Classroom Two. The five students that experienced statistical change on the parent ratings scales from the total group sample represent 15% of the total sample. The two students that experienced improvements are representative of 6% of the total sample, and the three that experienced a decrease in scores are representative of 9% of the total sample.

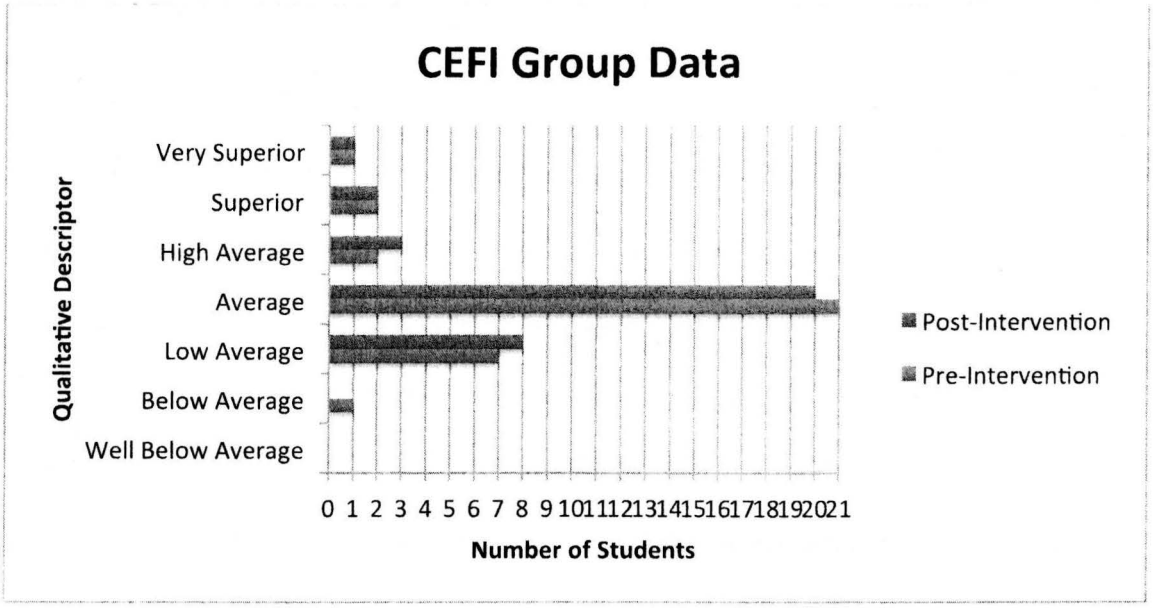

Figure 1. CEFI Group Data

Paired t-test analysis was conducted to compare the pre- and post-administrations of the CEFI Parent Rating scales for the entire sample (n=34). Results provided concurring evidence that there were no significant differences at the total sample for Total Score across the two administrations. The mean pre-test score for the 34 parent rating scales was a standard score of 99 (range = 79 – 128 = 49) and the post-test average score was 100 (range = 83 – 129 = 46); an increase of 1 point. The mean score for pre- and post-intervention are both within the Average range. For the parent scales, there was not a significant difference, $t(33) = -1.11$, $p = 0.27$.

A Tukey-Kramer Multiple Comparisons test was conducted to further examine for differences across the nine subtests of the CEFI. The Tukey-Kramer Multiple Comparison test is a single-step procedure for multiple comparison and statistical analysis. Raw data was used instead of ANOVA. This comparison evaluates differences between each scale versus every other scale. It explores whether means are significantly

different from each other. While the answer to this question is, there is a difference; results should be interpreted with caution. Since there were no significant omnibus results, the results gleaned from this test are likely not interpretable; however, still provide interesting insight for future research initiatives.

Because the paired sample t-test and Tukey-Kramer analyses yielded non-significant results, a G-Power test was conducted. G*Power (Version 3.1) software was used to conduct the statistical analysis described in the sections below. G*Power is free software that can be downloaded online. It is a general power analysis program that comes in two essentially equivalent versions: one runs under the Macintosh OS and the other was designed for MS-DOS. G*Power performs high-precision statistical power analyses for the most common statistical tests in behavioral research, including t-tests (independent samples, correlations, and any other t-test), F-tests (ANOVAS, multiple correlation and regression, and any other F-test), and Chi2-tests (goodness of fit and contingency tables) (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009).

Power analyses attempt to find a statistically significant difference when the null hypothesis is found to be true; it explores whether a real difference truly exists. Thus, the means and standard deviations from the parent rating scales of both classrooms (N = 34) were used to run a t-test analysis of the difference between two dependent means (i.e., matched pairs) within the G-Power 3.1.9.2 software. A two-tailed prediction was applied. Using the G-Power software, the *a priori* computes the required sample size given the alpha (□), power, and effect size. Results indicate that a target sample size should have

been 1,566 (N = 1,566). Thus, 1,566 first grade students (participants) as well as 1,566 pre- and post-behavior rating scales were needed in order to yield significance in such a study. The results are as follows:

Table 2

G-Power Analysis of Parent Rating Scales (Input Parameters)

Test Family:	t-tests
Statistical Test:	Means
Type of Power Analysis:	Post Hoc
Tail(s):	Two
Effect size dz:	0.0911583
□ err probability:	0.05
Power (1 – β err prob):	0.95

Table 3

G-Power Analysis of Parent Rating Scales (Group Parameters)

Mean	N	Standard Deviation
99.2941	34	12.84294
100.4412	34	12.30716

Table 4

G-Power Analysis of Parent Rating Scales (Output Parameters)

Non-centrality Parameter δ:	3.6073817
Critical t:	1.9614810
Df:	1565
Total sample size:	1566
Actual power:	0.9500361

CHAPTER V

DISCUSSION

Although at first glance it may appear that the intervention did not have an impact on the executive function of the participants (as measured by the lack of global significant differences on the pre-/post-scores of the CEFI), this study still highlights several important factors which need to be taken into account when considering the results reported above. Also, limitations to the current investigation should be examined, as well as future directions for research based on the current findings.

First, it is important to note that the current population did not exhibit EF deficits at onset; rather, the mean total score of the CEFI (both pre- and post-intervention, as reported by both raters) was within the average range. As the literature has indicated, children with poor EF tend to benefit the most from interventions designed to improve functioning. Since the children in the sample did not begin the intervention with any EF deficits, it is difficult to make comparisons about the impact of mindfulness approaches with children in previous research studies on the same topic, as many of those children presented with EF weaknesses initially.

Second, an analysis of individual constructs indicated that there were some significant differences at this level. Although total CEFI scores did not yield significant findings, thus minimizing the robustness of these content-level findings, the areas impacted are interesting and lend support to current scientific findings on the topic. For

both teachers and parents, emotion regulation was found to have significant differences with other factors (i.e., flexibility and self-monitoring).

Although no significant findings are apparent for executive function, it is unknown whether or not the intervention had an impact on equally important aspects of developmental functioning. Previous benefits of mindfulness interventions with children have included improved mental health and well-being, mood, self-esteem, self-regulation, positive behavior and academic learning improvements. As these factors were not explored as part of the current study (with the exception of self-regulation, which is a component of EF and was somewhat explored here under different nomenclature), it is unknown whether or not these areas were impacted as a result of the intervention. Future explorations of mindfulness interventions with school-aged children may wish to explore more areas of functioning other than EF.

Limitations of the Study

Several limitations are acknowledged as part of the current study. The biggest limitation would be the lack of teacher rating scales being collected for one site. Although parent ratings are important, this was a school-based study, and the lack of data regarding teacher perception at one site was an extreme limitation and makes it difficult to truly examine the data in whole at this time and make meaningful interpretations based on the dataset. A second limitation was that the sample did not focus on children with notable EF deficits. It is likely that a mindfulness intervention may have produced improvement in EF with children who had deficits or even below average EF rather than children whose EF capabilities were considered average. Future research may choose to

focus on samples of children with EF deficits or perhaps specific populations of students who typically have co-occurring EF deficits, such as children with ADHD. Although the current study did not find evidence of improved EF from the intervention, this is not to say that there were not benefits to the participants that were not measured by the current methodology. The use of mindfulness-based interventions in school settings is still a financially sound and easy to implement approach that should not be discounted. Future research should focus on such ways this can happen; specifically, as part of a tiered intervention approach.

The second school received vacillating administrative support likely because of competing demands on the principal's time and educational priorities. However, this lack of administrative support significantly impacts program implementation, staff buy-in and data collection. The area most impacted was staff buy-in which ultimately affected data collection. Without firm support, directives and follow-up, there was no onus or consequences for the lack of participation on behalf of the teachers. As a result, program implementation was seen as separate from teaching and learning. The teacher and teacher aide in the second classroom did not reinforce the principles nor practice the principles outside of the designated implementation time. In addition, neither teacher was held responsible for completing the pre- and post-behavior rating scales needed for program evaluation.

The validity of behavior rating scales is a common issue in research and practice. Relying on respondents, who have little knowledge of psychological constructs, to estimate performance on a Likert scale can adversely impact the results and

interpretations. Data collection from questionnaires can be hindered by issues of respondent's motivation and social desirability. In addition to variables of participant reactivity, score sensitivity is another area of concern. Although the CEFI is developed on sound theoretical underpinnings, questions about whether the measure was sensitive enough to parse out minor changes in core executive functions have to be considered. The CEFI purports to be a sound measure for progress monitoring interventions. However, little to no change were noted across administrations despite anecdotal records suggesting that students was motivated, engaged and able to recall key concepts from the intervention.

The age of the participants is another area of concern. Although early childhood is a fundamental developmental stage, is 6-8 years of age an appropriate developmental window for mindfulness training? According to Jean Piaget's developmental stages, first graders are on the upper cusp of the preoperational stage marked with symbolic play. The theorist warns that children in this stage are too young for logical thinking. Thus, MindUp activities like exploring scenarios and discussing brain functions might require more advanced cognitive reasoning than what's developmentally appropriate at this stage. Students who are between the ages of 6, 7 and 8 years of age might not have the maturation or cognitive dexterity to fully understand and develop this level of reasoning and awareness. In addition to cognitive readiness, focused attention and mindful listening may not be priority for students starving for attention and positive engagement in an educational setting where yelling and punitive discipline practices are embedded in the classroom structure.

Research indicates that mindfulness training has shown positive impacts on cognitive skills such at attention and inhibition. However, is mindfulness effective for developing the cognitive constructs of very young children in a brief intervention? Current mindfulness-based curriculums are typically short in duration lasting between eight to twelve sessions. However, for young children with low level of awareness in a developmental stage marked with movement and rapidly developing brains, twelve sessions may not be sufficient to enable students to fully develop the desired effect without generalization across settings. For better treatment effects, students would have benefited from generalization of mindfulness practices and principles across various academic subjects, and with a home-school collaboration so that parents were also employing the skills and techniques. Mindfulness as a universal Tier I intervention which persisted throughout the academic year and across academic grades might also improve the efficacy and integrity of the implementation.

Although there are no formal standards for power in statistical analysis, most researchers accept the value of 0.80 as the minimum standard for adequacy. Future studies may wish to use a priori power analysis when creating their research design to determine the minimum sample size required so that the study will be more likely to detect an effect. This analysis can also help determine the minimum effect size that is likely to be detected in a study using a given sample size (Ellis, 2010).

The CEFI Technical Manual indicates that the rating scale can be used to evaluate the effectiveness of an individual or group intervention over time. This should allow for researchers to determine if a particular program results in behavioral changes over time.

This topic has been viewed as controversial however, due to the inherent difficulty of determining if significant behavioral change is the result of random fluctuations in behavior, measurement error or the impact of an intervention (Jensen, 2001; Naglieri & Goldstein, 2013; Ogles, Lunnen & Bonesteel, 2001; Tingey, Lambert, Burlingame, & Hansen, 1996). Naglieri and Goldstein (2013) have accounted for this and advise that those using the CEFI to compare results over time must obtain scores from the same respondent and the interval should be greater than four weeks. The current study followed both of these parameters when comparing results over time, so a lack of significant findings cannot be attributed to the misuse of the tool as intended by the authors.

Although the authors of the CEFI indicate in the Technical Manual that group data can be analyzed to determine if significant change occurs; no clinical studies are cited in the Technical Manual or have been conducted to date that we are aware of. Although the current study did not produce significant results in terms of behavioral change, the findings in and of itself are a significant contribution to the scientific literature as well as to the utility of using the CEFI as a research tool.

Teaching children positive coping skills to manage stress and adversity at an early age is a novel idea. Childhood is a prime developmental stage for laying the groundwork for resiliency and mental health wellbeing. Needless to say, there is a growing need to help children cope with the stress and pressure of daily living. As a result, social-emotional learning has become just as essential as academic learning in our schools. Although the findings for mindfulness with young children are preliminary, there is a substantial body of evidence supporting social-emotional learning in academic

curriculums as viable options for improving academic performance, self-esteem, mood, concentration and pro-social behaviors. As a universal intervention, social-emotional learning programs are (1) more preventative and proactive; and (2) less stigmatizing because the entire school would be included. However, such interventions must be practical, cost-efficient and effective. Thus, further research is needed to determine the efficacy of mindfulness in academic settings as a universal, strength-based intervention for young children. Because of the validity concerns with questionnaires, more direct measures of assessment are needed. Future research designs should include mixed methods and multiple sources of data for convergence and solidification research findings.

The ultimate goal of research in education is to inform sound practices and procedures which maximize student learning. Finding even a modest correlation between mindfulness practices and executive functioning could have produced promising practices from school-ages children especially in urban school settings. However, the limitations and lessons learned from this current study can be used as a springboard for further research. The major limitations of this study can be categorized into three main domains: sample size, compliance and efficacy of the instrument and interventions.

The small sample size used in the study was identified as a major limitation. Results of the G-Power analysis suggested that a sample size of 1,566 was needed for significance. Thus, a broader sample might produce a large enough pool of data for relevant statistical analyses. Further research, with a larger sample size, is warranted to continue the investigation of EF, mindfulness and academic achievement. Although

participant compliance was another notable limitation, it is important to note that significant results were not found in either classroom. The classroom with no teacher rating scales rendered the same null results as the classroom with both teacher and parent rating scales. Thus, further research should explore the effectiveness of the treatment and progress monitoring. Even though compliance is essential, it is likely that either the intervention (i.e., MindUp) or the progress monitoring (i.e., CEFI) were not adequate. Specifically, future research should explore whether the CEFI, or any behavior rating scale for that matter (e.g., self-report and other respondent), is sensitive enough to detect and distinguish small changes in cognitive processes like attention, concentration, initiation, inhibition control, emotional regulation, and working memory. Additionally, it is important for further studies to explore whether mindfulness is a viable intervention for children in primary grades (e.g., Kindergarten to second grade). Mindfulness focuses on greater attention to thoughts and feelings; whether children as young as 5, 6 and 7 years of age can benefit from direct instruction in such advance cognitive alertness warrants more investigation. Lastly, compliance is fundamental for future research. Evidence which informs sounds practices rest upon participant cooperation and compliance. It is imperative that students are actively engaged, collaboration exists between home and school, and that teachers are invested and have onus in the study and its outcomes. Although educational settings often have limited resources, future studies might consider incentives to promote research compliance.

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VITAE

Lauren Barker is a nationally certified school psychologist currently practicing in Chicago Public Schools. She received her Education Specialist degree from The Chicago School of Professional Psychology in June 2011. Ms. Barker also holds Diplomat status with the American Board of School Neuropsychology. She has published peer-reviewed journal articles on neuropsychological constructs such as attention, executive function and large-scale brain systems. Ms. Barker has also co-authored chapters on the frontal lobes and their relationship to executive function, autism spectrum disorders and cross-cultural implications, and the cerebellum and its role in developmental language disorders. Most recently, Ms. Barker has co-authored a book that focuses on large-scale brain systems and how they impact neuropsychological assessment practices. Her future research interests include the impact of mindfulness-based practices with children as well as school neuropsychology.

Tasha Banks was born and raised in St. Louis, MO. After graduating from Webster Groves High School, she earned a Bachelor of Arts in Psychology from Tallageda College, Alabama (1997), a Master of Science in Counseling from Jacksonville State University, Alabama (1999), and an Educational Specialist degree from the Chicago School of Professional Psychology, Illinois (2012). From 1997 to 2015, Banks has provided strength-based supports and services to children and their families in an array of educational and therapeutic settings (e.g., detention facilities, group homes, psychiatric hospitals). Currently, Banks is an Assistant Clinical Professor and School Psychology Program Coordinator at Northern Arizona University.

DOCTORAL RESEARCH PROJECT APPROVAL SHEET

The Doctoral Research Project submitted by Lauren A. Barker and Tasha L. Banks has been read and approved by the following committee:

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The final copy has been examined by the director of the Doctoral Research Project and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the Doctoral Research Project is now given final approval by the committee with reference to content and form.

The Doctoral Research Project is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

March 30. 2016
Date

Director's Signature