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THE EFFECT OF SCHOOL-BASED MINDFULNESS INTERVENTION ON STUDENT ATTENTION AND EXECUTIVE FUNCTIONING: A META-ANALYSIS

A Dissertation

Submitted to the School Education

Duquesne University

In partial fulfillment of the requirement for

The degree of Doctor of Philosophy

By

Sarah E. Rea

December 2021

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2021

THE EFFECT OF SCHOOL-BASED MINDFULNESS INTERVENTION ON STUDENT ATTENTION AND EXECUTIVE FUNCTIONING: A META-ANALYSIS

By

Sarah Elizabeth Rea

Approved October 28, 2021

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ABSTRACT

THE EFFECT OF SCHOOL-BASED MINDFULNESS INTERVENTION ON STUDENT ATTENTION AND EXECUTIVE FUNCTIONING: A META-ANALYSIS

By

Sarah E. Rea

December 2021

Dissertation supervised by Kara McGoey, PhD.

Schools are facing increasing responsibility to foster the social-emotional development of students. One way in which schools can improve student functioning is through school-based mindfulness interventions. Using mindfulness practices, in particular, can teach students to increase their attention of surroundings and internal experiences, and awareness of their thoughts and behaviors. While the evidence-base for mindfulness interventions in schools continues to grow, there are several studies that show promising outcomes. The purpose of this study was to determine how large the effect sizes for school-based mindfulness studies are in regard to increasing student attention, cognitive flexibility, and working memory. Results indicate an overall positive, small-to-moderate effect of school-based mindfulness intervention on student attention and executive functioning. Results suggest that mindfulness techniques may be a reasonable addition to any classroom. Future research should work to clearly communicate the components of school-based mindfulness interventions. Additionally, future research should evaluate the benefit of using school-based mindfulness interventions with at-risk students or

students who receive special education services. Future meta-analyses would benefit from clear reporting of participant characteristics and investigation of narrow constructs relating to the behavioral and emotional functioning of students.

ACKNOWLEDGEMENT

I would like to first acknowledge and thank my advisor and committee chair, Dr. Kara McGoey, for her support, encouragement, and mentorship during my time at Duquesne. I am truly grateful for Dr. McGoey's guidance on my professional and personal development throughout my graduate school career. I would also like to acknowledge and thank my committee members, Dr. Ara Schmitt, Dr. Susan Rattan, and Dr. James Schreiber. Their continued support and guidance during this project has been invaluable, and has helped to build my confidence and skills as a researcher and clinician. I appreciate the flexibility of my committee as I navigated this dissertation process during a global pandemic. Without their flexibility and encouragement this process would have been overwhelming.

Additionally, I would like to thank my cohort members and friends. Thank you for your friendship and understanding. Thank you for navigating this process alongside me. You were always there to offer support and to celebrate each small success along the way. Specifically I would like to thank Dr. Cydney Quinn and Zachary Friedman for helping me navigate the coding of my data.

Finally, to my family, thank you for being a consistent system of support, encouragement, and confidence in my ability to achieve this goal. You were all instrumental in my ability to successfully complete this milestone.

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Chapter 1: Introduction

Schools increasingly face demands to meet federally mandated academic standards. Furthermore, they also have an increasing responsibility to promote children's social-emotional development (Zins et al., 2007a). National data suggest that approximately one in five children have a serious mental health disorder (National Institute of Mental Health, 2016). Additionally, 50% of all chronic mental illnesses are present in an individual by age fourteen (Kessler et al., 2005). Therefore, schools must address the emotional and behavioral needs of students (Maynard et al., 2017). The link between children's social-emotional and behavioral skills and academic achievement has been observed by educators and psychologists. The link between academic achievement and social-emotional functioning has not been as frequently studied in younger children; however, some research does suggest that this link can be evident as early as the preschool years (Arnold, 1997; Fantuzzo et al., 2003).

The relationship between academic underachievement and externalizing behavior seems to be bi-directional. Preschool and elementary school children with academic difficulties are at risk for heightened frustration, reduced interest in school, and diminished self-esteem. Consequently, children with academic difficulties may exhibit behavioral problems such as inattention, noncompliance, and classroom disruption (Arnold & Doctoroff, 2003). Children who exhibit externalizing behaviors may miss instruction or learning opportunities due to misbehavior and consequences. Academic skill deficits in school-age children are also related to attention problems, in particular (Finn et al., 1995).

Externalizing problems receive a lot of attention in educational research initiatives; however, a relationship between internalizing problems and general academic underachievement has been found in school-age children and adolescents (Rapport et al., 2001). Diminished

educational outcomes in later years (e.g., standardized test scores, grades, referrals for special education, etc.) has been linked to depression (Ialongo et al., 2001) and social withdrawal (Ollendick et al., 1992) in elementary school. Many children with internalizing symptoms may receive less attention or instruction from teachers and demonstrate less participation. Children with internalizing problems may also exhibit less concentration and motivation (Rapport et al., 2001). Education systems have begun to incorporate school-based interventions targeting social-emotional development in hopes of improving the overall functioning of students with or without externalizing or internalizing problems (Durlack et al., 2011). Social-emotional competence refers to an individual's ability to understand and control his or her own feelings, understand the feelings of others, get along with others, and build relationships. Social-emotional skills are important for the development of behaviors such as following directions, cooperating, using self-control, and paying attention.

Acquiring social-emotional skills is important. A lack of competence in this area can impact functioning at school, home, and in the community. Children may struggle to form healthy, successful relationships when they face behavioral, emotional, or social challenges (Early Childhood Mental Health, 2018). Young children, particularly up until the age of three, depend on relationships with adults to learn about themselves and the world (Aviles et al., 2006).

Significance of the Problem

Given this increased knowledge about the impact of social, emotional, and behavioral factors on learning and achievement, it is important for schools and educational policymakers to allocate attention and resources toward curriculum and programs to address children's and adolescent's social and emotional functioning (Zins & Elias, 2006). Parrish (2018) explains that modeling, a positive environment, and setting clear expectations are important tools for teaching

self-regulation. Modeling and observational learning are components of Albert Bandura's Social Learning Theory (1977). According to this theory, young people observe the people around them; these people are called models. Young people pay attention to some models, encode their behavior, and later may imitate the observed behavior (Bandura, 1977). Furthermore, discussion and reflection in an objective and nonjudgmental way can help improve behavior (Parrish, 2018). It is also important for adults to help young people slow down and choose a more appropriate response to reinforce self-regulation of behavior (Child Mind Institute, 2019). Teachers and parents can model self-reflection and self-awareness to help children and adolescents learn to make better choices (Child Mind Institute, 2019).

Within schools, social-emotional programs should include developmentally and culturally appropriate instruction in combining and applying social and emotional skills (Izard, 2002). Skills and competencies can be taught through modeling, practice, and application to different situations. Students who receive this direct instruction learn to generalize and use these behaviors daily (Weissberg et al., 1989). Social-emotional learning curriculums are often seen in elementary school settings; however, middle school students also benefit from this kind of instruction. When adolescents are provided environments that focus on improvement of social-emotional skills, they will subsequently experience increased success when navigating developmental tasks while also increasing academic achievement (Aviles et al., 2006). One way of supporting social-emotional functioning may be through the incorporation of mindfulness into school curricula. Teaching mindfulness may help young people engage more fully in the present moment and increase their awareness of their internal and external experiences (Zelazo & Lyons, 2012). Although school-based mindfulness curricula differ in approach and expected outcomes, several studies have focused on the effect that mindfulness practices have on executive functions

specifically (Butzer et al., 2015; Flook et al., 2010; Flook et al., 2015; Napoli et al., 2005; Parker et al., 2014; Semple et al., 2010; White, 2012).

Theoretical Basis for Mindfulness

Mindfulness historically utilizes meditation practices from Buddhist origins (Burke, 2010) and has been practiced in many philosophical and psychological traditions, such as in Buddhist psychology (Brown et al., 2007). In the past, mindfulness practice has been used to attain lasting happiness and increase insight into existence (Holzel et al., 2011). More recently, the concept and practice of mindfulness has evolved to include underlying components of attention/inattention, attitude, exposure, self-management, relaxation, observing, acting with awareness, and more (Brown et al., 2007; Baer, 2003; Baer et al., 2006; Shapiro et al., 2006). In contrast to some concentration practices, mindfulness aims to train the mind to be aware at all times rather than on emptying the mind of all thought (Seigel et al., 2009).

Theoretical Basis of Executive Function

Several theories and conceptualizations of EF are based on factor analytic studies paired with neuropsychological data. Alexander and Stuss (2000) and Anderson (2002) discuss a model of EF that includes four different domains. The first domain, attentional control, involves selective attention, self-regulation, self-monitoring, and inhibition. Individuals use attentional control to attend to stimuli in the environment for sustained periods of time and inhibit responses. Individuals with attentional control deficits may be impulsive, struggle to finish tasks, and make errors without correcting them. The second domain, information processing, includes cognitive efficiency, fluency, and processing speed. Impairment in this domain would slow an individual's output and result in response delays, hesitant responding, and slow reaction times. The next domain, cognitive flexibility, is the ability to shift between cognitive sets, learn from

errors, plan alternative strategies, divide attention, and process varying kinds of information. Individuals with deficits in cognitive flexibility may struggle to adapt to task demands as they change. Finally, the goal setting domain refers to the ability to develop new plans, plan ahead, and work efficiently. Those with impairments in the goal-setting domain may struggle to problem solve, plan, organize information, and develop strategies (Alexander & Stuss, 2000; Anderson, 2002).

Literature Review

Research regarding mindful approaches to improving wellbeing has spread across fields related to healthcare, neuroscience, psychology, and even business. Specifically, interest in the effects of mindfulness has focused on adult populations. However, mindfulness is a concept that is gaining popularity in the field of child development. Growing concentration on mindfulness practices may be due to growing evidence of positive effects on cognitive processes (Maynard et al., 2017). Research indicates that participation in mindfulness practice improves performance on self-regulation (Heeren et al., 2009) and emotion regulation (Finucane & Mercer, 2006) measures. Additionally, cognitive functions such as attention, working, memory and overall executive functioning are increased through mindfulness practice (Chambers et al., 2008; Chiesa et al., 2011). These results were found in adult populations; however, they are also considered important factors for school success.

Mindfulness can help young people learn and reinforce self-regulation skills and other social-emotional skills. Studies have shown that teaching mindfulness to preschool-age children can have a positive effect on their behavior as well as their social-emotional development in and out of the classroom (Hooker & Fodor, 2008). Remaining mindful can allow a child to presently experience his or her emotions and thoughts as well as understand how the environment impacts

his or her reactions. In providing the child the skills to become more aware of how he or she takes in and processes the environment, it can enhance his or her abilities to also be aware of others and engage in socially appropriate interactions that are mutually beneficial (Zelazo & Lyons, 2012). Mindfulness interventions continue to be investigated in school settings to help examine their value and patterns of effects.

Initial studies of mindfulness interventions with children have shown promising outcomes (Kuyken et al., 2013). In the extant literature, mindfulness training has been connected with increased self-regulation and attention and reduced psychological stress in young people (Barnert et al., 2013; Bögels et al., 2008; Coholic et al., 2012; Flook et al. 2010; Semple et al., 2010; Schonert-Reichl & Lawlor, 2010). For example, first and third grade children who engaged in yoga and breath awareness training showed better attention and social skills, as well as lessened test anxiety, compared to students who did not receive mindfulness training (Napoli et al., 2005). Practicing mindful awareness through training programs has also been linked to improvement in self-regulation skills. Of interest, children with initially insufficient self-regulation showed the most improvements (Flook et al., 2010). Interventions based in mindfulness have demonstrated reduced anxiety, improved behavior ratings related to Attention Deficit Hyperactivity Disorder (ADHD), and increased emotion regulation and selective attention (Broderick & Metz, 2009; Napoli et al., 2005). These changes in student outcomes may result in better classroom behavior.

Executive functions are essential factors for school success and have been found to predict academic achievement beyond levels of general intelligence (Blair & Razza, 2007). Consequently, it is best to train children in such skills during early periods of development, as the ability to effectively and efficiently engage in EF processes develops throughout childhood

and adolescence. It is important to aid the development of EF at an early age to positively impact ongoing development (Klingberg et al., 2002). Executive function processes are central to an individual's performance in areas of cognition, behavior, emotion, and social interaction (Anderson, 2002). Executive functions such as cognitive flexibility, inhibitory control, and working memory, can impact several areas of functioning (Anderson, 2002; McCloskey et al., 2009; Miyake et al., 2000; Zelazo et al., 2008). Research indicates that poor EF is associated with deficits in cognition, socio-emotional regulation, and academic functioning (Biederman et al., 2004, Blair, 2002). These deficits related to poor EF can appear as difficulty concentrating, difficulty understanding cause and effect, difficulty understanding mental states, and difficulty controlling impulses (Riggs et al., 2006). Growing research indicating longitudinal and concurrent associations between deficits in EF and both academic functioning and socio-emotional development demonstrates the impact of EF on many areas of development and growth (Blair & Razza, 2007; Riggs et al., 2003).

The Problem Statement

Although the use of MBIs in schools has increased greatly in recent years, significant examination of the outcomes of such interventions has not been systematic (Maynard et al., 2017). Although there is empirical evidence for the use of MBIs with adult populations, it is suggested that children and adolescents may not experience similar benefits as they are not developmentally able to complete the cognitive tasks required of mindful practices (Maynard et al., 2017). This is just one explanation for the lack of significant evidence of MBI outcomes in schools. In contrast, there is also research indicating that children are able to benefit from mindfulness in ways similar to adults (Davis, 2012; Hooker & Fodor, 2008). Due to the abstract nature of some mindfulness or meditative practices, adaptations may need to be made to ensure

interventions are developmentally appropriate. Ultimately, further research must be conducted to add to the research base and to better understand the usefulness of MBIs for children and adolescents. The research regarding MBIs and outcomes related to cognition, socialization, and psychological health is growing. In particular, researchers have invested efforts into investigating the effects that mindfulness interventions have on EF skills.

Previous Meta-Analyses and Reviews

Several meta-analyses have examined the effects of MBIs on cognitive and social-emotional outcomes of children and adolescents. Dunning and colleagues (2019) specifically examined the efficacy of MBIs in studies with a randomized, controlled trial (RCT) design. After conducting a systematic literature search, Dunning and colleagues (2019) completed analyses using 33 RCT studies. Dunning and colleagues (2019) found significant positive effects of MBIs compared to controls on variables such as mindfulness, attention, executive functioning, anxiety/stress, depression, and negative behaviors. Small effect sizes were reported. However, when Dunning and colleagues (2019) restricted their analysis to include on RCT studies with active control groups, significant effects of MBIs were only found for outcomes such as mindfulness, depression, and anxiety/stress.

Klingbeil and colleagues (2017) also examined mindfulness-based interventions with youth by conducting a meta-analysis of 76 studies with participants ranging in age from 4-18. Klingbeil and colleagues (2017) separately analyzed controlled and uncontrolled studies on two broad outcome measure categories. One category of outcome measures was related to skills targeted through MBIs (e.g., cognitive flexibility, mindfulness, attention, and meta-cognitive skills). The second category of outcome measures was related to secondary outcomes of MBIs (e.g., academic achievement and emotional/behavioral regulation). Results of this meta-analysis

indicate that MBIs led to significant improvements across all outcome measures. Small to small-to-moderate effect sizes were reported for uncontrolled studies while small-to-moderate effects were reported for controlled studies (Klingbeil et al., 2017).

Zoogman and colleagues (2015) also conducted a meta-analysis of controlled and uncontrolled studies related to mindfulness interventions with children and adolescents aged 6 to 21 years old. Zoogman and colleagues (2015) reviewed a total of 20 studies published between 2004 and 2011. Results of this meta-analysis indicated that MBIs significantly improved children and adolescents' psychological symptoms, mindfulness, and attention. Small to small-to-moderate effect sizes were reported (Zoogman et al., 2015).

Two previous meta-analyses have been conducted on MBIs delivered in school settings. Zenner and colleagues (2014) analyzed 24 studies within school populations before 2012. Participants within these studies ranged from 6 to 19 years of age. Zenner and colleagues (2014) found a significant benefit of MBIs on measures of cognition, stress, and resilience. Effect sizes were found to range from small-to-moderate to large (Zenner et al., 2014). No significant improvements were reported in regard to MBIs effects on reducing emotional problems (Zenner et al., 2014). Finally, Maynard and colleagues (2017) conducted a systematic review and meta-analysis examining the effects of MBIs delivered to school-age participants ages 4 to 20 years of age. Overall, this meta-analysis included 35 controlled and uncontrolled studies and found that MBIs significantly improved cognitive and social emotional skills with small effect sizes. There were no reported significant improvements on academic and behavioral outcomes (Maynard et al., 2017).

Research Questions and Hypotheses

The current meta-analysis will attempt to address the limitations of previous literature through answering the following research questions:

Research Question 1: How large are the effect sizes for school-based mindfulness studies?

Hypothesis 1: School-based mindfulness studies report moderate or small-to-moderate effect sizes.

Research Question 2: After adjusting for sample size, how large are the effect sizes related to increasing student attention?

Hypothesis 2: Effect sizes related to increasing student attention are moderate or small-to-moderate.

Research Question 3: After adjusting for sample size, how large are the effect sizes related to increasing student working memory?

Hypothesis 3: Effect sizes related to increasing student working memory are moderate or small-to-moderate.

Research Question 4: After adjusting for sample size, how large are the effect sizes related to increasing student cognitive flexibility?

Hypothesis 4: Effect sizes related to increasing student cognitive flexibility are moderate or small-to-moderate.

Research Question 5: How much do the effect sizes from school-based mindfulness interventions differ based on the length of the implemented intervention?

Hypothesis 5: Effect sizes from school-based mindfulness interventions will increase as the length of intervention increases.

Research Question 6: How much do the effect sizes from school-based mindfulness interventions differ based on the age of students?

Hypothesis 6: Effect sizes from school-based mindfulness interventions will increase as student age increases.

Research Question 7: How much do the effect sizes from school-based mindfulness interventions differ based on the gender of students?

Hypothesis 7: Effect sizes from school-based mindfulness interventions will not differ based on the gender of students.

Conclusion and Summary

It is important for schools and educational policymakers to devote attention and resources to curricula and programs to address social and emotional functioning (Zins & Elias, 2006). One way of supporting social-emotional functioning, the goals of SEL, and to teach self-regulation skills may be through the incorporation of mindfulness into school curricula. A commonly used definition from Kabat-Zinn (2003a, p. 145) states that mindfulness is "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience." Many definitions of mindfulness include practices of training attention (Burke, 2010; Semple & Lee, 2008) and indicate that attention regulation is a core component in mindfulness training (Semple & Lee, 2008). Ultimately, further research must be conducted to add to the research base and to better understand the usefulness of MBIs for children and adolescents.

Previous meta-analyses provide preliminary support for the effectiveness of using mindfulness practices with children and adolescents (Dunning et al., 2019; Maynard et al., 2017; Klingbeil et al., 2017; Zenner et al., 2014; Zoogman et al., 2015). Although school-based

mindfulness curricula differ in approach and expected outcomes, several studies have focused on the effect that mindfulness practices have on executive functions, specifically. Mindfulness interventions in schools have reported outcomes related to increased attention (Semple et al., 2010; Napoli et al., 2005; Butzer et al., 2015), self-regulation (White, 2012; Flook et al., 2010), inhibitory control, cognitive flexibility (Parker et al., 2014; Flook et al., 2015), and working memory (Parker et al., 2014). In many cases, these studies have used either parent- or teacher-report of EF skills rather than direct assessments. Although there are studies that utilize direct EF assessments to gauge outcomes of mindfulness interventions, this is still a new area of research being increasingly utilized as the evidence base continues to expand. However, although research in this area is ongoing, no systematic or meta-analytic efforts to understand these outcomes have been completed.

Chapter II: Literature Review

What is Mindfulness?

Definitions of mindfulness vary slightly across the literature. There is not yet consensus on a universal, operational definition of mindfulness. A commonly used definition from Kabat-Zinn (2003a, p. 145) states that mindfulness is "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience." As opposed to psychotherapy, the purpose of mindfulness is not to change thoughts or experiences. Instead, the purpose is to be aware of thoughts and feelings without the need to react (Bostic et al., 2015). While some definitions suggest that mindfulness is a single factor construct (Brown & Ryan, 2004), several definitions indicate that mindfulness is multidimensional (Aguirre & Galen, 2013; Baer et al., 2006; Dimidjian & Linehan, 2003; Shapiro et al., 2006). Baer and colleagues (2006) report five factors of mindfulness: nonreactivity to inner experience, observing/attending to sensations/perceptions through thoughts/feelings, acting with awareness, describing feelings, and nonjudging of inner experience. This definition relates to several other mindfulness definitions that indicate the importance of similar components. However, most definitions of mindfulness, Baer and colleagues (2006) definition included, describe skills that fall within the three foundational components of any mindfulness practice: intention, attention, and attitude (Shapiro et al., 2006).

The first foundational component of mindfulness, intention or purpose, encompasses an individual's reason for engaging in mindfulness practices (Shapiro et al., 2006). This component requires an individual to identify a set goal prior to participating in a mindfulness intervention. For example, the goal may be to decrease stress. Setting such a specific goal reminds the

individual of the purpose of their mindfulness practice. This subsequently allows the individual to increase their use of mindfulness during present moment interactions (Shapiro et al., 2006).

The second foundational component of mindfulness is paying attention. Many definitions of mindfulness include practices of training attention (Burke, 2010; Semple & Lee, 2008) and indicate that attention regulation is a core component in mindfulness training (Semple & Lee, 2008; Bishop et al., 2004). When an individual monitors and directs the focus of attention, awareness of current experiences increases. This subsequently increases the individual's ability to attend to thoughts, feelings, and actions (Bishop et al., 2004). Mindfulness interventions teach individuals to shift attention to the present moment. If their attention strays, they are taught to purposefully shift their attention back to the present moment (Singh et al., 2010). When individuals practice present moment awareness and attention, they are better able to address their current needs and engage in deliberate actions (Van deer Oord et al., 2012). While being aware and paying attention in the moment is a component of many mindfulness definitions (Bishop et al., 2004; Black & Fernando, 2014; Bostic et al., 2015; Kabat-Zinn, 2003a), some definitions also elaborate on the subsequent skill development that occurs and the mental connections that are formed. Bishop and colleagues (2004) indicate that increasing present-moment attention may lead to greater cognitive flexibility and less reliance on presumptions and expectations to manage behavior. Bishop and colleagues (2004) proposed an operational definition of mindfulness that, in addition to including awareness of experiences, incorporates reactions to experiences. Black and Fernando (2014) place emphasis on mindful reactions by defining mindfulness as a trained skill that requires intentionally paying attention without reacting in a habitual way or experiencing exaggerated thoughts. In other words, the use of mindfulness as a skill should deter

people from reacting impulsively with emotional outbursts or from forming elaborated conclusions or opinions that are unfounded (Black & Fernando, 2014).

The third foundational component of mindfulness, attitude, requires an individual to attend to the present moment in a non-judgmental and receptive way. By attending to the moment in a conscious way, individuals can learn to accept thoughts and feelings that emerge, even if they are unpleasant (Duncan et al., 2009). Furthermore, Bostic and colleagues (2015) highlight the importance of an individual recognizing the relationship among his or her thoughts, emotions, and behaviors. By being cognizant of these relationships, a mindful individual can better understand and accept his or her habits or patterns of responding.

With the fundamental skills of mindfulness in mind, two definitions effectively recognize the foundational elements of mindfulness that can fit into one of two categories: what a mindful person does and how mindful actions are accomplished. Dimidjian and Linehan (2003) report six distinct elements, three in each category. They indicate that a mindful person can observe, describe, and participate. To do so, a mindful person must be nonjudgmental, one-minded, and effective. Similarly, Aguirre and Galen (2013) explain important components of mindfulness by separating them into WHAT skills and HOW skills. As with Dimidjian and Linehan (2003), observing, describing, and participating are considered WHAT skills. Successful use of these WHAT skills would include paying attention with all senses, describing facts about a situation rather than drawing conclusions, and participating fully in the moment without becoming distracted (Aquirre & Galen, 2013). Again, in line with Dimidjian and Linehan (2003), HOW skills require an individual to be intentional, nonjudgmental, nonreactive, and effective. It is also important that individuals only focus on one thing at a time. Acting mindfully requires an individual to intentionally choose to be mindful. In order to do this the individual must avoid

quick judgments that are not factual, avoid multitasking, and avoid needless responses to situations (Aguirre & Galen, 2013). Individuals increase their levels of mindfulness when engaging in mindfulness interventions and practice utilizing the three components discussed as the foundation. As individual's increase their mindfulness, additional expansive skills develop (Shapiro et al., 2006).

Theoretical Foundation of Mindfulness

Mindfulness historically utilizes meditation practices from Buddhist origins (Burke, 2010) and has been practiced in many philosophical and psychological traditions, such as in Buddhist psychology (Brown et al., 2007). In the past, mindfulness practice has been used to attain lasting happiness and increase insight into existence (Holzel et al., 2011). More recently, the concept and practice of mindfulness has evolved to include the underlying components of attention/inattention, attitude, exposure, self-management, relaxation, observing, acting with awareness, and more (Brown et al., 2007; Baer, 2003; Baer et al., 2006; Shapiro et al., 2006). In contrast to some concentration practices, mindfulness aims to train the mind to be aware at all times rather than on emptying the mind of all thought (Seigel et al., 2009).

Mindfulness and Social-Emotional Development

The utility of mindfulness for adult populations has been researched extensively. However, research regarding mindfulness with children and adolescents is more limited. The increase in the use of mindfulness with children and adolescents can be directly tied to school's increasing responsibility to provide social-emotional intervention. Educational policies implemented over the last twenty years have led school districts in the U.S. toward improving standards related to academics and accountability (Maynard et al., 2017). Children in today's public-school system are spending increased time each year meeting testing requirements for

federal, state, and local mandates (Hart et al., 2015). Blame for increased levels of student anxiety and stress has in part been placed on expanded testing requirements and modified academic standards (Merikangas et al., 2010). Schools not only face increasing demands to meet federally mandated academic standards but have an increasing responsibility to promote children's social-emotional development (Zins et al, 2007a).

National data suggest that approximately one in five children have a serious mental health disorder (National Institute of Mental Health, 2016). Additionally, 50% of all chronic mental illnesses are present in an individual by age fourteen (Kessler et al., 2005). Therefore, schools must address the emotional and behavioral needs of students (Maynard et al., 2017). Educational settings have the ability to provide interventions to impact academic performance and emotional growth. When schools acknowledge the effect of social-emotional development on academic outcomes they can successfully engage in identification of and intervention for students with social-emotional deficits (Aviles et al., 2006). By providing social-emotional services schools can address classroom concerns related to behavior and other academic outcomes. As a result, education systems have begun to incorporate school-based interventions targeting social-emotional development in hopes of improving the overall functioning of students, including those without identified behavioral or academic deficits (Durlack et al., 2011). Although schools are responsible for both the cognitive and emotional development of students, they often have limited resources to intervene in all the necessary areas. Schools are faced with limited time for intervention and must prioritize evidence-based approaches that target multiple skill areas (Durlack et al., 2011).

Social-Emotional Development

Social-emotional competence refers to an individual's ability to understand and control his or her own feelings, understand the feelings of others, get along with others, and build relationships. Social-emotional skills impact the development of behaviors such as following directions, cooperating, using self-control, and paying attention. Acquiring social-emotional skills is important, as a lack of competence in this area can impact functioning at school, home, and in the community. Children may struggle to form healthy, successful relationships when they face behavioral, emotional, or social challenges (Early Childhood Mental Health, 2018). Young children, particularly up until the age of three, depend on relationships with adults to learn about themselves and the world (Aviles et al., 2006).

When adults engage in positive relationships with children and adolescents, they foster successful social-emotional development. There are several actions caregivers can take to support the social-emotional development of children. Aviles and colleagues (2006) indicate that caregivers should be nurturing and responsive to promote a healthy emotional climate in the home. Caregivers can also support child development by modeling appropriate behavior, providing affection, and being considerate of others' feelings, needs, and wants. Caregivers should express pride in children's accomplishments and interest in their daily activities. During times of stress, parents and other caregivers should provide additional encouragement and support (Early Childhood Mental Health, 2018). Children develop several social and emotional skills prior to school entry. Development of social-emotional skills is crucial as children prepare to learn upon entering school (Klein, 2002). When children enter the school setting, they continue to develop social and emotional skills that are important for academic achievement (Aviles et al., 2006).

Stages of Social-Emotional Development

Social and emotional development occurs through several stage or age level tasks. When viewed through the context of developmental psychopathology, social-emotional development can be understood as occurring under one of two processes (Aviles et al., 2006). The process of multifinality assumes that children and adolescents can start developing at the same starting point, but that they ultimately will not experience the same developmental outcomes. Equifinality is the opposite process wherein children and adolescents start developing at different points but experience the similar developmental outcomes. Educators and administrators must understand that children and adolescents may develop at different rates or experience different outcomes to select social-emotional interventions that will benefit students at different stages (Aviles et al., 2006).

From birth to twelve months, typical children show several seemingly small signs of normal social and emotional development. For example, they cry to express needs, spontaneously smile in response to certain stimuli (e.g., caregiver's voice, face, and smile), and respond to their names. Furthermore, children in this stage are increasingly able to self-soothe when upset, show emotions (e.g., frustration, interest, and surprise), and respond positively to playful interactions (Brazelton & Greenspan, 2000). Parents can encourage social and emotional development from birth to three months of age by spending time holding/touching the baby, smiling often, and talking softly. Placing babies so they can watch people and activities can also encourage social-emotional development. Between the ages of four to seven months, parents can positively respond to the babies' attempts at communication (e.g., coos and giggles) and verbalize names of things, people, body parts, etc. As the child reaches twelve months of age,

parents can provide a safe environment for exploring and encourage participation in games where the child can interact (Early Childhood Mental Health, 2018).

When children move into the next stage of social and emotional development, beginning around 12 months of age and ending around 36 months of age, they begin to become more independent and test their limits. At this stage, children begin to follow rules, defend possessions, initiate activities, and comfort others. Children at this age increasingly enjoy playing by themselves or around other children. Children also begin to express new emotions like shame, affection, jealousy, and pride. Nonetheless, this stage of development is also known for temper tantrums and resistance to discipline (Brazelton & Greenspan, 2000). Parents can encourage social-emotional development at this stage by praising independent actions, encouraging exploration and challenging activities, providing social opportunities, engaging in pretend play, and teaching children about their feelings (Early Childhood Mental Health, 2018).

The social-emotional development of preschoolers, between the ages of three and five, is evidenced by improved recognition of others' emotions, understanding of others' feelings, and turn-taking. In this stage, children increase skills related to pretend play, sharing, taking responsibility for actions and expressing feelings through words. Children at this stage need clear and consistent rules (Brazelton & Greenspan, 2000). Children at this stage of development should be encouraged to play in small groups, be given choices, and be encouraged to make decisions (Early Childhood Mental Health, 2018). Once children reach school age, between the ages of six and eight, they begin to identify and describe their own feelings, understand their feelings, and understand consequences for actions. School-age children also often offer help when others are upset. They increasingly take turns and share (Brazelton & Greenspan, 2000). At this age, teachers and caregivers should encourage children to make friends and express their

feelings. Adults should set rules and limits, model behaviors, and praise good behavior (Early Childhood Mental Health, 2018).

As young adolescents enter middle school, they continue to develop socially and emotionally. Between the ages of eleven and thirteen, adolescents increase their ability to engage in interpersonal reasoning (Selman, 1980). They are growing to understand how motives and behavior are related in groups of people. These developments can lead to a better understanding of others' feelings. Additionally, they are able to analyze their own behavior as well (Snowman & McCown, 2015). Emotionally, adolescents tend to experience more intense highs and lows (Silk et al., 2003). Adolescence can be a difficult time for some, and educators may observe feelings of depression, anxiety, or differences in self-esteem. Also, during this stage of development many adolescents wish to conform to peer expectations, which can affect their school performance (Juvonen et al., 2000). If students at this age lack social-emotional competence, their connection to school may progressively lesson (Durlack et al., 2011). Skills, including social-emotional competence that adolescents obtain in school serve as foundations for future success in education and employment (Zins et al., 2007b)

Social Emotional Learning

Social Emotional Learning (SEL) is one method that can be used to encourage social-emotional development (CASEL, 2017). Social Emotional Learning (SEL) is a method used to improve students' ability to handle daily tasks and difficulties. The goal of SEL is to address five interrelated components associated with cognition, affect, and behavior. These components are self-awareness, responsible decision making, self- management, social awareness, and relationship skills. These components of SEL relate to academic performance, engagement, and

student behavior (CASEL, 2017) and provide a foundation for better adjustment (Greenberg et al., 2003).

The first component, self-awareness, is the ability to recognize one's emotions and acknowledge one's abilities and limits, allowing individuals to recognize how thoughts, emotions, and values influence behavior. Self-awareness can help foster the components of responsible decision-making and self-management. Responsible decision-making includes making choices that are personally and ethically sound, the ability to analyze and solve problems, and evaluating the consequences for self and others. Self-management is the ability to manage one's emotions and behaviors. To use successful self-management, an individual must be able to control impulses, manage stress, and set goals. Finally, the component of social awareness refers to the ability to understand how to appropriately interact with others, and includes the critical skills of empathy, perspective-taking, and respect. Social awareness can influence the component of relationship skills which involves the ability to form reciprocal and positive relationships and handle conflict efficiently (CASEL, 2017).

Within schools, SEL programs should include developmentally and culturally appropriate instruction in combining and applying social and emotional skills (Izard, 2002). SEL skills and competencies can be taught through modeling, practice, and application to different situations. Students who receive this direct instruction learn to generalize and use these behaviors daily (Weissberg et al., 1989). Additionally, SEL programs address social-emotional development by creating environments influenced by community-building activities and appropriate classroom management (Schaps et al., 2004).

Social-emotional learning curriculums are often seen in elementary school settings; however, middle school students also benefit from this kind of instruction. At this age it's

important for SEL programs to have goals related to managing emotions, setting realistic goals, making decisions, understanding the thoughts and feelings of others, forming healthy relationships, and getting along with others (Snowman & McCown, 2015). When adolescents are provided environments that focus on improvement of these skills, they will subsequently experience increased success when navigating developmental tasks while also increasing academic achievement (Aviles et al., 2006).

Social Emotional Competence and Executive Functioning

Social-emotional development has been connected to performance in domains of learning and academic achievement. Research shows that social-emotional skills are related to greater academic success, impulse control, concentration, and attention in the school environment. Conversely, a lack of social-emotional competence can lead to problems in academics, socialization, and behavior (Denham & Brown, 2010). Academic performance, school engagement, and externalizing and internalizing behaviors are directly related to several social-emotional factors: emotion regulation, social awareness, self-awareness, effortful control, relationships skills, self-management, and decision making (Brackett & Rivers, 2014; Denham & Brown, 2010). Throughout early childhood, children learn to understand emotions and learn important social and cognitive skills. In the early years, skill development focuses on emotions and positive relationships. As they age, children are expected to have the ability to sit still, focus, follow directions, and more (Denham & Brown, 2010).

Upon starting school, children learn and practice skills related to communication, decision making, self-awareness, social awareness, and self-regulation (Denham & Brown, 2010). Self-regulation, along with other cognitive processes such as inhibitory control, cognitive flexibility, and working memory, fall under the "umbrella term" of executive function (EF).

Executive functions are core developmental skills that underlie most behaviors throughout the lifespan. Some researchers conceptualize and explain EF as a singular or global construct that controls and directs all thoughts and behaviors (Brown, 2005; Goldberg, 2001). However, the term EF covers related yet independent processes important for deliberate and goal-oriented behaviors (Gioia et al., 2001; McCloskey et al., 2009), such as attention. Overall, EFs direct an individual's ability to process perceptions, thoughts, emotions, and behaviors in a purposeful, goal-driven, and organized way (McCloskey et al., 2009). Thus, executive functions play an important role in children and adolescent's development of social-emotional skills (Riggs et al., 2006).

Executive functions are essential factors for school success and have been found to predict academic achievement beyond levels of general intelligence (Blair & Razza, 2007). Consequently, it is best to train such skills during early periods of development, as the ability to effectively and efficiently engage in EF processes develops throughout childhood and adolescence. Previous research indicates that EF skills begin to develop in the toddler years and develops more rapidly during early childhood (Diamond, 2002; Waber et al., 2007). Development of EFs is not linear, instead it likely occurs in bursts. Also, because EF is not a single construct but is instead comprised of several related but separate skill sets, different components of EF may develop at different times and in different ways (Anderson, 2002). It is important to aid the development of EF at an early age to positively impact ongoing development in the variety of skills that are subsumed under EF (Klingberg et al., 2002).

Research indicates that the development of EF occurs in three major growth spurts. Between birth and age five, children perform goal-directed behaviors that aid with problem solving. Children at this stage of development exhibit some self-control to inhibit a behavior or

maintain a current action. As children age they are able to inhibit certain behaviors and select a new response. Between the ages of seven and nine, a child's brain goes through a period of myelination that results in the ability to make strategic choices and use reasoning skills. At this age, children become more efficient and experience a burst in processing speed abilities. Between the ages of 11 and 13, children's information processing, goal setting, and cognitive flexibility become more mature (Anderson, 2002). Development of EF does not end after this stage. As children move through adolescence and young adulthood, behaviors related to EF continue to become refined and increase in efficiency.

Executive function processes are central to an individual's performance in areas of cognition, behavior, emotion, and social interaction (Anderson, 2002). Executive functions such as cognitive flexibility, inhibitory control, and working memory can impact several areas of functioning (Anderson, 2002; McCloskey et al., 2009; Miyake et al., 2000; Zelazo et al., 2008). In particular, mental set shifting, working memory, and response inhibition are important for behavior regulation (Anderson, 2002; Blair & Razza, 2007). For an individual to regulate his or her behavior, he or she must be able to reason through a situation, manipulate information, and inhibit impulsive responses.

Research indicates that poor EF is associated with deficits in cognition, socio-emotional regulation, and academic functioning (Biederman et al., 2004, Blair, 2002). These deficits related to poor EF can appear as difficulty concentrating, difficulty understanding cause and effect, difficulty understanding mental states, and difficulty controlling impulses (Riggs et al., 2006). Growing research indicating longitudinal and concurrent associations between deficits in EF and both academic functioning and socio-emotional development demonstrates the impact of EF on many areas of development and growth (Blair & Razza, 2007; Riggs et al., 2003).

Key Executive Functions

There are several processes associated with EF including but not limited to: self-regulation, attention, cognitive flexibility, and working memory.

Self-Regulation. Not only is self-regulation a core EF, but, as discussed previously, it is also involved in social-emotional development. Self-regulation in particular is an important skill to develop as it refers to the ability to direct or control one's attention, emotion, thoughts, and actions (Calkins, 2007). Self-regulation involves two processes. The first process can be termed inhibitory control and refers to an individual's ability to stop behaviors. The second process refers to the ability to make one's self perform a certain task that may not be preferred (Calkins, 2007). The development and subsequent long-term effects of self-regulation skills have been the focus of an abundance of research. This research suggests that good self-regulation skills in early childhood may have positive effects in adulthood. For example, self-regulation skills in early childhood may lead to better social skills (Eisenberg et al., 2004; Spinrad et al., 2006) and a better ability to cope with stress (Mischel et al., 2011). Research indicates that a change in the development of self-regulation occurs between the ages of three and seven. At this developmental stage, children transition from reactive behaviors to self-regulated ones (Diamond, 2002). Students with better developed self-regulation skills are more likely to exhibit increased concentration and attention abilities in school. They are also more likely to display better impulse control and less externalizing behaviors (Eisenberg et al., 2010; McClelland et al., 2007).

Attention. Attention is a primary cognitive process since we must attend to information before we can process it. Peterson and Posner (2012) discuss an attention system theory that has three components: the alerting system, orienting system, and executive attention system. The

alerting system is an arousal process in which an individual responds to the environment. This component of the attention system theory is not goal-directed but is instead driven by the stimulus. The orienting system is goal-directed and involves controlled attention for a novel stimulus. The executive attention system allows an individual to inhibit and disinhibit the orienting response. This part of the attention system involves selective and sustained attention (Peterson & Posner, 2012).

There are several forms of attention that may be used depending on the particular situation. Focused, or directed, attention is the ability to attend and orient to a stimulus and then respond. Divided attention is the ability to attend and respond to multiple stimuli at once. Alternating attention or shifting requires mental flexibility so an individual can shift his or her focus to different tasks. Sustained attention, also referred to as vigilance, is the ability to attend to a task for an extended period of time, regardless of how repetitive or boring the task is (Mirsky & Duncan, 2001). Finally, selective attention is described as maintaining a cognitive set despite distracting stimuli (Diamond, 2002).

Working Memory. Working memory is an EF that is important for encoding and retrieving information from long-term memory. One widely accepted theory of working memory is from Baddeley (2010). This theory describes a central executive and two mechanisms involved in storage of information. The central executive involves attention and manipulation of information. The phonological loop stores auditory information, and the visual-spatial sketchpad stores visual-spatial information. Both storage mechanisms use the functions of passive storage and rehearsal (Baddeley, 2010).

Cognitive Flexibility. Cognitive flexibility refers to the ability to shift mental sets to refocus attention to stimuli that is relevant (Diamond, 2002). Another important aspect of

cognitive flexibility is the ability to consider different representations of information to make goal-directed decisions (Jacques & Zelazo, 2005). Cognitive flexibility processes are affected by an individual's tendency to perseverate. Perseverative behaviors are common in infancy and decline during early and middle childhood (Anderson, 2002).

Mindfulness, Social Emotional Competence, and Executive Functioning

As previously mentioned, developed EF skills allow individuals to process perceptions, thoughts, emotions, and behaviors in a purposeful, goal-driven, and organized way (McClosky et al., 2009), skills that are directly relevant to mindfulness. As previously stated, mindfulness is a concept that is gaining popularity in the field of child development. Growing concentration on mindfulness practices may be due to growing evidence of positive effects on cognitive processes (Maynard et al., 2017). Research indicates that participation in mindfulness practice improves performance on self-regulation (Heeren et al., 2009) and emotion regulation (Finucane & Mercer, 2006) measures. Additionally, cognitive functions such as attention, working, memory and overall executive functioning are increased through mindfulness practice (Chambers et al., 2008; Chiesa et al., 2011). These results were found in adult populations; however, they are also considered important factors for school success.

Mindfulness can help children and adolescents learn and reinforce self-regulation skills and other social-emotional skills. Studies have shown that teaching mindfulness to preschool age children can have a positive effect on their behavior as well as their social-emotional development in and out of the classroom (Hooker & Fodor, 2008). Remaining mindful can allow children to presently experience their emotions and thoughts as well as understand how the environment impacts their reactions. In providing the child the skills to become more aware of how he or she takes in and processes his/her environment, it can enhance the abilities of being

aware of others and engaging in socially appropriate interactions that are mutually beneficial (Zelazo & Lyons, 2012). Mindfulness interventions continue to be investigated in school settings to help examine their value and patterns of effects.

The evidence-base for school-based mindfulness programs continues to develop; nonetheless, several programs have reported favorable outcomes for students. Studies have shown that teaching mindfulness to young people may have a positive effect on behavior (Bakosh et al., 2015; Hooker & Fodor, 2008; Semple et al., 2010; Shomaker et al., 2017), social-emotional development (Hooker & Fodor, 2008), emotional regulation (Broderick & Metz, 2009; Metz et al., 2013), and mental health (Edwards et al., 2014; Semple et al., 2010). Although school-based mindfulness curriculums differ in approach and expected outcomes, several studies have focused on the effect that mindfulness practices have on executive functions, specifically (Butzer et al., 2015; Flook et al., 2010; Flook et al., 2015; Napoli et al., 2005; Parker et al., 2014; Semple et al., 2010; White, 2012).

Initial studies of mindfulness interventions with children have shown promising outcomes (Kuyken et al., 2013). In the literature, mindfulness training has been connected with increased self-regulation and attention and reduced psychological stress in young people (Barnert et al., 2013; Bögels et al., 2008; Coholic et al., 2012; Flook et al. 2010; Semple et al., 2010; Schonert-Reichl & Lawlor, 2010). For example, first and third grade children who engaged in yoga and breath awareness training showed better attention and social skills, as well as lessened test anxiety as compared to students who did not receive mindfulness training (Napoli et al., 2005). Practicing mindful awareness through training programs has also been linked to improvement in self-regulation skills. Of interest, children with initially insufficient self-regulation showed the most improvements (Flook et al., 2010). Interventions based in

mindfulness have demonstrated reduced anxiety, improved behavior ratings related to Attention Deficit Hyperactivity Disorder (ADHD), and increased emotion regulation and selective attention (Broderick & Metz, 2009; Napoli et al., 2005). These changes in student outcomes may result in better classroom behavior.

Mindfulness training during late elementary school has been found to be related to inhibitory control in early adolescence. This suggests that interventions based in mindfulness can improve cognitive functioning (Oberle et al., 2012). Flook and colleagues (2010) found that a mindfulness-based intervention with elementary students resulted in increases in overall EF, specific areas of EF, behavior regulation, and metacognition. These findings were based on parent and teacher report. Both parents and teachers indicated that students showed progress in the ability to initiate, monitor, and shift; all three skills are practiced through mindfulness training. You initiate by bringing attention to an activity (e.g., breath). Monitoring involves awareness of where one's attention lies. Finally, individuals who can shift are able to bring attention back to the activity (e.g., breath; Flook et al., 2010). Initial findings from this study indicate that using MAPs such as appropriate games and exercises is a useful tool for enhancing EF skills in elementary students. Results are especially apparent for students that already display EF deficits. Students who showed lower EF skills prior to MAPs training displayed average EF skills after training was completed (Flook et al., 2010). Furthermore, mindfulness training with adolescents diagnosed with ADHD, Oppositional Defiant (ODD)/Conduct Disorder (CD), or Autism Spectrum Disorder (ASD) improved externalizing and internalizing behaviors, attention, and overall happiness (Bögels et al., 2008).

Flook, Goldberg, Pinger, and Davidson (2015) examined the effects of a mindfulness-based kindness curriculum on students' self-regulation, executive function, and prosocial

behavior. A sample of 68 preschool children participated in this 12-week program that taught attention, emotion regulation, and kindness. The intervention focused on empathy, gratitude, and sharing. The outcome variables were assessed through a delay of gratification task, card sort task, flanker task, and a sharing task. Teachers were also asked to rate students on their social competence. After the intervention was concluded, the intervention group showed more improvement in social competence and earned higher report card grades in select areas of learning, health, and social-emotional development. The control group was found to be more selfish over time as they did not share as frequently with other classmates when prosocial behavior was assessed. Children in the intervention condition had lower executive functioning and social competence measures at baseline and demonstrated larger improvements compared to children in the control group. The limitations of this study are the short intervention period and the lack of diversity in the setting that was used. Nevertheless, the results of this research support the use of a mindfulness-based kindness curriculum for promoting self-regulation and prosocial behavior in young children (Flook et al., 2015).

Schonert-Reichl and colleague (2015) compared outcomes for students who participated in a mindfulness SEL program, MindUP, which was discussed above, with those of students who completed a social responsibility program. A sample of four 4th and 5th grade classrooms were assigned to receive one of the school-based interventions. Those that received the mindfulness SEL curriculum practiced skills like mindful smelling/tasting, perspective taking, empathy, optimism, and gratitude. Students who participated in the social responsibility program practiced skills such as sharing, problem-solving, respect, and responsibility. Outcomes were measured by using behavioral assessments of executive functioning (e.g., flanker task and dots task), measurement of cortisol in saliva, child self-reports, peer-ratings of prosocial behavior, and

grades at the end of the year. Students in the mindfulness SEL group showed significant increases in executive functions on cognitive tasks. In particular, they made improvements when asked to use skills of inhibition, working memory, and cognitive flexibility (Schonert-Reichl et al., 2015).

The State of Intervention

Given this increased knowledge about the impact of social, emotional, and behavioral factors on learning and achievement, it is important for schools and educational policymakers to put attention and resources towards curriculum and programs to address social and emotional functioning (Zins & Elias, 2006). Parrish (2018) explains that modeling, a positive environment, and setting clear expectations are important tools for teaching self-regulation. Furthermore, engaging in discussion and reflection in an objective and nonjudgmental way can help improve behavior (Parrish, 2018). It is also important for adults to help children and adolescents slow down and choose a more appropriate response to reinforce self-regulation of behavior (Child Mind Institute, 2019). Teachers and parents can model self-reflection and self-awareness to help young people learn to make better choices (Child Mind Institute, 2019). As the literature suggests, one way of supporting social-emotional functioning, the goals of SEL, and to teach self-regulation skills may be through the incorporation of mindfulness into school curricula. Teaching mindfulness may help children and adolescents engage in the present moment and increase their awareness of their internal and external experiences (Zelazo & Lyons, 2012).

The idea behind mindfulness is to make children more aware of themselves and their environment. Children are taught to be more aware of their own emotions, other's emotions and even physical actions such as their own breathing and eating (Thompson & Gauntlett-Gilbert, 2008). More recently, mindfulness research has focused on school-based interventions rather

than on clinical therapeutic interventions. School-based mindfulness interventions may be more beneficial than clinical interventions as they can reach a larger number of children (Webster-Stratton & Reid, 2010) and may offer an increased chance for generalization to daily activities. Mindfulness can be used to support goals related to social-emotional learning. It can help children learn and strengthen self-regulation skills and other social-emotional skills. Regulation of attention and emotions provides children with a foundation for school readiness and allows them to learn and maintain social relationships (Blair, 2002). Of particular note, it may be beneficial to offer self-regulation training in early childhood as children's cognitions and behaviors are quite malleable in this stage of development. Teaching mindfulness to young children can positively affect their behavior and social-emotional development in the classroom and other settings (Hooker & Fodor, 2008).

Although there is empirical evidence for the use of MBIs with adult populations, it is suggested that children and adolescents may not experience similar benefits. This suggestion indicates that children and adolescents are not developmentally able to complete the cognitive tasks required of mindful practices (Maynard et al., 2017). This is just one explanation for the lack of significant evidence of MBI outcomes in schools. In contrast, there is also research indicating that children are able to benefit from mindfulness in ways similar to adults (Davis, 2012; Hooker & Fodor, 2008). Due to the abstract nature of some mindfulness or meditative practices, adaptations may need to be made to ensure interventions are developmentally appropriate. Ultimately, further research must be conducted to add to the research base and to better understand the usefulness of MBIs for children and adolescents.

Mindfulness-Based Interventions for Children

Just as there are several definitions of mindfulness, there are several practices and methods for use in mindfulness training. Although many mindfulness programs incorporate yoga exercises, existing literature does not support yoga alone as an "evidence-based practice" due to methodological limitations of the relevant research (Smith & Mendelson, 2014). Common mindfulness programs that have been evaluated in the literature often combine practices such as mindful movement (i.e., yoga), breathing, and/or guided meditation. Together, these practices may provide individuals with several chances to practice paying attention in a mindful way and practice being present in the moment in a mindful way (Parker et al., 2014).

Techniques such as mindful awareness practices (MAPs) are often incorporated into mindfulness programs and interventions. Mindful awareness practices are exercises meant to encourage a mental state of attention to present experience (Bishop et al., 2004; Siegel, 2007). This mental state of awareness can be increased by practicing forms of meditation, yoga, and Tai-Chi (Melbourne Academic Mindfulness Interest Group, 2006). One common MAPs exercise involves attention regulation to a present moment or activity such as breathing. An individual must pay attention to the movement of his or her diaphragm as he or she breathes in and out. Activities such as this often result in attention shifting from the target (e.g., movement of diaphragm) to something separate. Recognition of this shift in attention allows the individual's attention to be returned to the original activity or experience. Practicing mindfulness in this way and through other techniques requires practice and repetition to become proficient (Flook et al., 2010).

Mindfulness-based interventions can be feasible with children and adolescents with appropriate adaptations (Zelazo & Lyons, 2012). According to a systematic review completed by

Maynard and colleagues (2017), Mindfulness Based Stress Reduction (MBSR), Mindfulness Based Cognitive Therapy for Children (MBCT-C) and Learning to Breathe are some of the most popular MBIs used in school settings. Mindfulness Based Stress Reduction (MBSR; Kabat-Zinn, 2003b) and MBCT-C (Semple et al., 2005) are both MBIs adapted from their original forms for use with children and adolescents. There are also several mindfulness and yoga programs designed for school use. Lawlor (2014) compiled a list of yoga programs, classroom interventions, and teacher trainings that have been used.

Mindfulness Based Stress Reduction

Mindfulness Based Stress Reduction is a group intervention that takes place over eight sessions. Each session is two and a half hours in length and includes a daily homework assignment. The purpose of MBSR is to reduce stress by instructing participants in mindful awareness through yoga and meditation. Participants are also taught components of self-awareness, so they can be aware of their experiences, thoughts, and feelings without evaluation (Kabat-Zinn, 2003b). Several researchers have adapted MBSR for use with children in school settings. Sibinga and colleagues (2013) found that male students who participated in MBSR showed better coping, less anxiety, and less rumination. Additionally, adolescents who participated in MBSR at school showed changes in perceived stress and depression (Edwards et al., 2014). Bakosh and colleagues (2015) found that an adapted MBSR curriculum was related to increased math and science grades and decreased disruptive behaviors.

Mindfulness Based Cognitive Therapy

Mindfulness Based Cognitive Therapy for Children was created by Segal, Williams, and Teasdale (2002) for use with adults with depression. It was adapted for use with children to address anxiety (Semple et al., 2010; Semple et al., 2005). During MBCT-C, participants learn

mindfulness practices such as attention to breath and awareness of the moment. Cognitive interventions are also used to increase self-regulation. This children's version is 8 weeks long, has shorter sessions, and uses smaller groups (Semple et al., 2010). Research using MBCT-C as an intervention report decreased attention problems and anxiety symptoms in participants (Lee et al., 2008; Semple et al., 2010). Semple and colleagues (2010) reported that students with elevated anxiety before participation in MBCT-C showed significant decreases in self-reported anxiety symptoms after the intervention was implemented. Additionally, parent ratings of behavior indicated that the children's attention increased after participating in MBCT-C (Semple et al., 2010).

Learning to BREATHE

Learning to BREATHE (Broderick & Metz, 2009) was specifically designed for use in classroom settings. This program requires teachers to complete an 8-week MBSR training and a two-day in-service curriculum training. After completion of this training, teachers can choose between a six-, twelve-, or eighteen-session version. All versions offer 45-minute sessions that are integrated into classroom instruction for fifth through twelfth grade students. This curriculum aims to increase attention, emotion regulation, gratitude, compassion, and stress management skills. By participating in this intervention, children learn how to use mindfulness in their everyday lives. Each lesson involves discussion, activities, and mindfulness practice. Much of the evidence supporting the Learning to BREATHE curriculum involves high school students. After participating in the Learning to BREATHE intervention at school, students reported increased emotion regulation (Broderick & Metz, 2009; Metz et al., 2013), resilience (Felver et al., 2018), and self-acceptance (Broderick & Metz, 2009). Students also experienced decreases in

depressive symptoms (Shomaker, et al., 2017) and feelings of tiredness (Broderick & Metz, 2009).

Mindful Awareness for Girls through Yoga

Mindful Awareness for Girls through Yoga is a program for fourth and fifth grade girls that is implemented by a trained mindfulness instructor. This intervention uses an adapted MBSR curriculum with an increased focus on yoga. This program also differs from traditional MBSR as it has shorter sessions and incorporates more repetition of skills. Like MBSR, the Mindful Awareness for Girls through Yoga curriculum utilizes daily homework assignments to help students generalize what they are learning (White, 2012). Girls who participate in this curriculum report higher levels of self-esteem and self-regulation (White, 2012). Contrary to expectations, girls who participated in this intervention reported higher levels of perceived stress; however, they also reported a higher frequency of coping. These results may be due to an increased awareness of stressors while practicing mindfulness (White, 2012).

The Attention Academy

The Attention Academy Program can be used for first through third grade students. The 45-minute sessions are integrated into physical education classes on a bimonthly basis by trained mindfulness instructors. Students learn breathing exercises, body movement tasks, and mindful body scans. Each session also has a debriefing activity. The goal of this program is to teach students to pay attention and focus in the classroom (Napoli et al., 2005). Outcomes of this curriculum were assessed through teacher ratings of behavior, student ratings of test anxiety, and student performance on tasks of selective and sustained attention on the *Test of Everyday Attention for Children (TEA-Ch).* Results suggest that students who participated in the Attention Academy Program experienced fewer social problems, decreased test anxiety, and increased

selective attention scores when compared to students who did not participate in the program. There was no change in performance on tasks measuring sustained attention (Napoli et al., 2005).

MindUP

The MindUP program is an easily implemented program that includes 12 classroom lessons for teachers to use. One lesson lasting 40-50 minutes was used per week. Although there is only one lesson a week, short mindfulness practices are incorporated every day. At three points throughout the day, teachers ask students to focus on their breathing and practice attentive listening. The 12 lessons are meant to promote students' executive functioning and self-regulation. Students are asked to participate in activities such as mindful listening and mindful tasting. Students' social-emotional understanding is targeted by using literature that encourages empathy and perspective-taking. The MindUP curriculum also focuses on creating a positive mood and climate by practicing optimism and gratitude. Students that received the MindUP curriculum showed improvements in cognitive and emotional control, perspective-taking, empathy, optimism, mindfulness, and prosocial behaviors. Additionally, symptoms of depression decreased along with peer-reported aggression (Schonert-Reichl et al., 2015).

Yoga 4 Classrooms

The Yoga 4 Classrooms program incorporates brief exercises taught by classroom teachers. Implementation of this program is supported by staff development, parent education, and adult classes for school staff (Lawlor, 2014). Yoga 4 Classrooms fosters students' physical, social, and emotional wellness and focuses on students' readiness to learn and the school's overall climate. The primary goal of this program is to improve students' focus and teach them about the importance of physical and mental health. After completing this program, students

have the skills to improve concentration, listening skills, confidence, and more (Yoga 4 Classrooms, 2019). Outcomes of this program were assessed through teacher observations of behavior and student levels of cortisol. Levels of cortisol were measured to understand the programs effects on student levels of stress. After participation in Yoga 4 Classrooms, students showed a significant decrease in cortisol levels from pre-program levels. Second grade students improved in teacher observed areas of social interaction, attention, concentration, academic performance, stress, confidence, and general mood. These same improvements were not reported for third-grade students (Butzer et al., 2015).

Master Mind

Master Mind program is also taught by trained classroom teachers. This program is meant to be delivered once a day over a 4-week span. There are twenty lessons that last approximately 15-minutes, each. Every week, four lessons introduce new concepts or skills while the fifth lesson allows students to practice and apply the mindfulness practices they've learned. The curriculum includes four sections representative of foundations of mindfulness: awareness of body, awareness of feelings, awareness of thoughts, and awareness of relationships. Important features of the Master Mind program are mindful breathing, mindful journeys (e.g., meditations), mindful movements (e.g., yoga), applications of mindfulness, and daily practice (Parker et al., 2014). Results indicate that after participation in this program, students' performance on tasks of executive functioning improved. Additionally, teachers reported fewer social problems and aggression for students that completed the Master Mind program with no reported changes in teacher-rated attention (Parker et al., 2014).

Mindful Schools

Mindful Schools is a kindergarten through twelfth grade intervention that can be implemented by classroom teachers. This program offers online or in-person training on the fundamentals of mindfulness. This Mindfulness Fundamentals course helps teachers improve their personal mindfulness practices. Teachers are also offered a course called Mindful Educator Essentials. This course teaches educators how to incorporate mindfulness into their classrooms. Both courses are completed online through videos, readings, reflections, and mindfulness practices. Upon completion of these courses, educators are prepared to complete a 16-week long intervention in the classroom (Mindful Schools, 2016). Evidence suggests that use of the Mindful Schools program decreased depression symptoms in a population of minority children (Liehr & Diaz, 2010). Further examination of this program, however, is not present in the literature. Statistical evidence reported by Mindful Schools suggests that teachers who use this program largely recommend it to others and experience lower levels of stress. Educators also report that they see improvements in focus, emotion regulation, compassion, and engagement (Mindful Schools, 2016). However, empirical research has not been conducted to validate these reports.

Previous Meta-Analyses and Reviews

Three previous meta-analyses have been conducted to examine the overall effects of MBIs on both cognitive and social-emotional outcomes of children, without including a school-component. Zoogman and colleagues (2015) conducted a meta-analysis of controlled and uncontrolled studies related to mindfulness interventions with children and adolescents aged 6 to 21 years old. Zoogman and colleagues (2015) reviewed a total of 20 studies published between 2004 and 2011. Results of this meta-analysis indicated that MBIs significantly improved children

and adolescents' psychological symptoms, mindfulness, and attention. Small to small-to-moderate effect sizes were reported (Zoogman et al., 2015). Notably, Zoogman and colleagues' (2015) study had several methodological limitations. For example, they used Becker's (1988) *del* as the effect size for studies with pre-post data and for studies with control groups that were not actively engaged in an alternative intervention. Morris and DeShon (2002) indicate that this method can potentially bias outcomes.

Klingbeil and colleagues (2017) also examined mindfulness-based interventions with youth by conducting a meta-analysis of 76 studies with participants ranging in age from 4-18. Klingbeil and colleagues (2017) separately analyzed controlled and uncontrolled studies on two broad outcome measure categories. One category of outcome measures was related to skills targeted through MBIs (e.g., cognitive flexibility, mindfulness, attention, and meta-cognitive skills). The second category of outcome measures was related to secondary outcomes of MBIs (e.g., academic achievement and emotional/behavioral regulation). Results of this meta-analysis indicate that MBIs led to significant improvements across all outcome measures. Small to small-to-moderate effect sizes were reported for uncontrolled studies while small-to-moderate effects were reported for controlled studies (Klingbeil et al., 2017).

Dunning and colleagues (2019) specifically examined the efficacy of MBIs in studies with a randomized, controlled trial (RCT) design. After conducting a systematic literature search, Dunning colleagues (2019) completed analyses using 33 RCT studies. Dunning and colleagues (2019) found significant positive effects of MBIs compared to controls on variables such as mindfulness, attention, executive functioning, anxiety/stress, depression, and negative behaviors. Small effect sizes were reported. However, when Dunning and colleagues (2019) restricted their analysis to include only RCT studies with active control groups, significant effects of MBIs were

only found for outcomes such as mindfulness, depression, and anxiety/stress. Notably, Dunning and colleagues (2019) only included studies in which the intervention was facilitated by a trained mindfulness instructor and in which the intervention included sustained mindfulness meditation practice. Although some school-based interventions provide brief mindfulness training to facilitators along with a focus on meditation practice, this is not standard for school-based MBIs.

Two previous meta-analyses have been conducted on MBIs delivered in school settings. Zenner and colleagues (2014) analyzed 24 studies within school populations before 2012. Participants within these studies ranged from 6 to 19 years of age. Zenner and colleagues (2014) found a significant benefit of MBIs on measures of cognition, stress, and resilience. Effect sizes were found to range from small-to-moderate to large (Zenner et al., 2014). No significant improvements were reported in regard to MBIs effects on reducing emotional problems (Zenner et al., 2014). Zenner and colleagues (2014) calculated a synthetic effect size per study by using unweighted averages. Hedges and colleagues (2010) indicate that this method results in a loss of information. A more accurate estimate of effects can be found by using more recent meta-analytic techniques (Klingbeil et al., 2017). Zenner and colleagues (2014) also reported that they compared parent and teacher ratings to an outcome domain that included both performance-based measures and self-report ratings together. Further concerns regarding Zenner and colleagues' (2014) outcome domains were present. For example, some of the constructs included in their "emotional problems" domain would not typically be categorized as such (e.g., maladaptive behaviors). Furthermore, their cognitive performance domain included a wide arrange of constructs such as creativity tests, grades, and attention tests (Zenner et al., 2014).

Finally, Maynard and colleagues (2017) conducted a systematic review and meta-analysis examining the effects of MBIs delivered to school-age participants ages 4 to 20 years of age.

Overall, this meta-analysis included 35 controlled and uncontrolled studies published between 1990 and 2015. Outcomes were separated into five domains: cognition, academic performance, behavior, socioemotional, and physiological. Like Zenner and colleagues (2014), Maynard and colleagues (2017) included constructs such as executive function, attention, cognition, and memory in their cognition domain. They found that MBIs significantly improved cognitive and social emotional skills with small effect sizes. There were no reported significant improvements on academic or behavioral outcomes (Maynard et al., 2017).

Future Directions

Although the use of MBIs in schools has increased greatly in recent years, significant examination of the outcomes of such interventions has not been systematic (Maynard et al., 2017). Previous meta-analyses provide preliminary support for the effectiveness of using mindfulness practices with children and adolescents (Dunning et al., 2019; Maynard et al., 2017; Klingbeil et al., 2017; Zenner et al., 2004; Zoogman et al., 2015). However, the research regarding MBIs and outcomes related to cognition, socialization, and psychological health is growing. In particular, researchers have invested efforts into investigating the effects of mindfulness interventions upon EF skills. In many cases, these studies have used either parent- or teacher-report of EF skills rather than direct assessments. Although there are studies that utilize direct EF assessments to gauge outcomes of mindfulness interventions, this is still a new area of research being increasingly utilized as the evidence base continues to expand. However, although research in this area is ongoing, no systematic or meta-analytic efforts to understand these outcomes have been completed.

Summary

It is important for schools and educational policymakers to put attention and resources toward curriculum and programs to address social and emotional functioning (Zins & Elias, 2006). One way of supporting social-emotional functioning, the goals of SEL, and to teach self-regulation skills may be through the incorporation of mindfulness into school curricula. A commonly used definition from Kabat-Zinn (2003a, p. 145) states that mindfulness is "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience." Many definitions of mindfulness include practices of training attention (Burke, 2010; Semple & Lee, 2008) and indicate that attention regulation is a core component in mindfulness training (Semple & Lee, 2008). Ultimately, further research must be conducted to add to the research base and to better understand the usefulness of MBIs for children and adolescents.

The evidence-base for school-based mindfulness programs continues to develop; nonetheless, several programs have reported favorable outcomes for students. Studies have shown that teaching mindfulness to children may have a positive effect on behavior (Bakosh et al., 2015; Hooker & Fodor, 2008; Semple et al., 2010; Shomaker et al., 2017), social-emotional development (Hooker & Fodor, 2008), emotional regulation (Broderick & Metz, 2009; Metz et al., 2013), and mental health (Edwards et al., 2014; Semple et al., 2010). Although school-based mindfulness curricula differ in approach and expected outcomes, several studies have focused on the effect mindfulness practices have on executive functions specifically (Butzer et al., 2015; Flook et al., 2010; Flook et al., 2015; Napoli et al., 2005; Parker et al., 2014; Semple et al., 2010; White, 2012). Previous meta-analyses of school-based mindfulness have shown favorable outcomes on measures of cognition and social-emotional skills (Maynard et al., 2017; Zenner et

al., 2014). However, given that mindfulness practice heavily relies on executive functioning skills, examination of the overall effect of school-based MBIs on direct assessment of executive functions is warranted.

Chapter III: Methodology

Selection of Studies

An extensive literature search was conducted to identify relevant published and unpublished studies for this analysis. A computerized search was performed using PsycINFO, ERIC, ProQuest Theses and Dissertation databases, and Medline. No limitations regarding publication date were set and searches were performed from June 6, 2021 to June 13, 2021. The following search terms were used: "mindfulness intervention OR meditation OR present awareness AND executive function OR attention OR hyperactivity OR impulsivity AND school-based OR in-school OR after school program OR school based intervention. After conducting the literature search, titles and abstracts of the identified articles were screened to include or exclude studies based on the criteria outlined below. The second screening stage consisted of obtaining the remaining full-text articles and again determining eligibility based on the inclusion and exclusion criteria outlined below. Next, references from the identified full-text articles were reviewed to locate additional articles not included in the online databases. Unpublished data was requested by contacting primary authors of the identified articles to determine if the authors had any works in review or press that may be appropriate for inclusion in the sample.

Inclusion and Exclusion Criteria

A study had to meet the following criteria to be included for analysis:

(a) study author(s) identified mindfulness as a main component of the intervention,

(b) the intervention occurred during school or as part of a school-based after school program,

(c) school-age children (i.e., ages 3-21) were direct recipients of the intervention,

(d) direct, performance-based measures of executive functioning and/or attention were utilized pre- and post-intervention

(e) studies reported quantitative data (i.e., effect sizes/data convertible to effect sizes),

(f) studies were available in the English language.

The initial literature search using the designated search terms resulted in 539 studies, with 526 articles remaining after searching for duplicate articles. The titles and abstracts for these remaining articles were screened. Twenty-seven studies were reviewed as potentially meeting inclusion criteria. Four hundred and ninety-nine studies were excluded due to a lack of school age populations/settings, lack of direct executive function/attention outcome measures, lack of mindfulness component in intervention, and non-experimental designs (e.g., reviews, meta-analyses, case studies, qualitative designs). The final sample consisted of 10 studies (Figure 1).

Study Coding

Each study was independently evaluated by two coders for the following information: (see Appendix A for coding manual):

1. Study characteristics such as participant demographics (e.g., age, gender, ethnicity, grade) and number and duration of sessions;
2. Methodological characteristics such as presence and nature of control groups, presence or absence of random assignment, type of outcome measures;
3. Effect size statistics (e.g., sample size, means, standard deviations) when available, significance tests when effect size statistics are not available, or calculated effect size.

Coding Outcomes

Ten articles were coded into Excel (Figure 3.1). Eight studies utilized a control condition and were used for analysis. The remaining two articles did not utilize a control group and are reviewed in the discussion. The author and second raters coded one article together during training. Six articles were coded independently by all raters to assess the reliability of the first

rater. The level of inter-rater reliability for nominal variables was determined by calculating Krippendorff's alpha, which ranged from 0.6 to 1. The level of inter-rater reliability for continuous variables was determined by calculating Pearson correlation coefficients (Table 3.1).

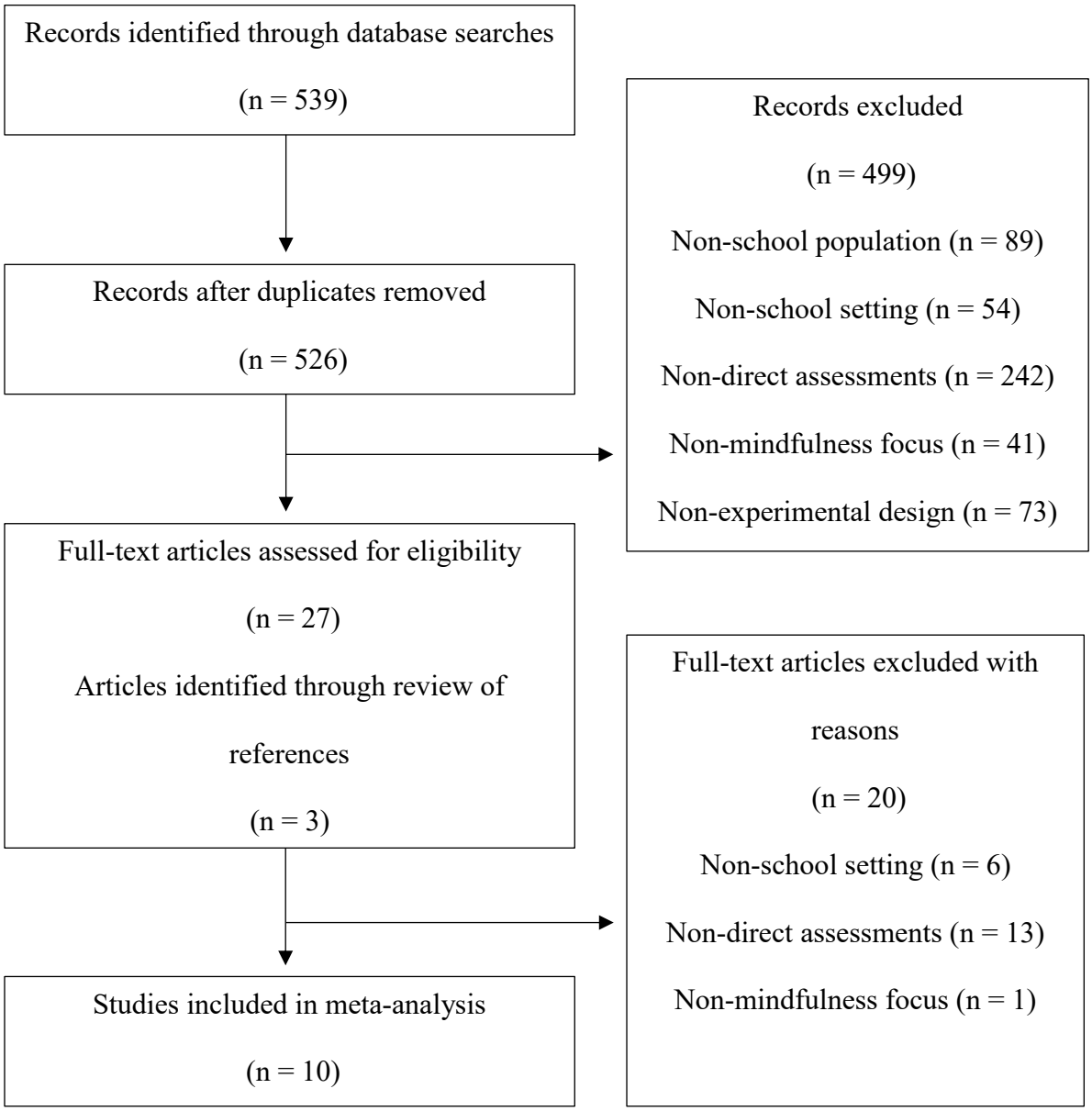

Figure 3.1. Flow diagram of the study selection process.

Table 3.1

Interrater Reliability of Continuous Variables

Variable	Pearson Correlation Coefficient
Publication year	1.0**
Total N started	0.999**
Treatment N	0.99**
Control N	0.991**
Total N completed	0.892*
Intervention length	1.0**
Number of sessions	0.999**
Number mindfulness sessions	1.0**
Age mean	0.997**
Age standard deviation	1.0**
Treatment N completed	0.925**
Control N completed	0.979**
Control mean (pre-test)	1.0**
Control mean (post-test)	0.997**
Treatment mean (pre-test)	0.995**
Treatment mean (post-test)	0.996**
Control standard deviation (pre-test)	0.993**
Control standard deviation (post-test)	0.997**
Treatment standard deviation (pre-test)	0.990**
Treatment standard deviation (post-test)	0.988**

F value	1.0**
df value	1.0**
T value	1.0**
Chi square value	1.0**
r^2 value	1.0**

**Correlations are significant at the 0.01 level (2-tailed)

*Correlations are significant at the 0.05 level (2-tailed)

Unit-of-Analysis Problem

The unit-of-analysis problem is a common problem encountered during meta-analyses (Harrer et al., 2022). Studies often include multiple groups and/or use more than one instrument to measure outcomes, which results in more than one effect size. However, when a study contributes more than one effect size the core assumption of independence of effect sizes is violated (Higgens et al., 2019; Harrer et al., 2022).

When more than two groups are present in a study, an issue referred to as double-counting occurs. This issue accounts for the fact that the presence of three or more groups results in some information related to effect size computation being included twice or more. When double-counting occurs, resulting effect sizes are correlated and the resulting standard error is overestimated. Therefore, the weight given to these effects in the meta-analysis is inflated and the results are misleading. Harrer and colleagues (2022) recommend three options to correct this common problem: split the sample size of the shared group, combine groups, or remove groups. Although splitting the sample size of the shared group solves the double-counting issue, this method is not ideal because it does not resolve the issue related to the correlation of effect sizes (Higgens et al., 2019). Although combining groups resolves both issues (e.g., overestimation of

standard error and correlation of effect sizes), it is not a viable option when the intervention groups are not similar. That is, if the intervention groups are so different that they cannot be compared, it is difficult to separate the results and determine the true effectiveness of the intervention (Harrer et al., 2022). The final option, removing groups, resolves the unit-of-analysis problem; however, there is potential to lose potentially relevant information. In the current study, two articles contained more than two groups: Quach and colleagues (2016) and Wimmer and colleagues (2016). Quach and colleagues (2016) utilized two intervention groups: a mindfulness meditation group and a Hatha yoga group. Both interventions utilize a mindfulness component; thus, the groups were combined to resolve the unit-of-analysis problem. Wimmer and colleagues (2016) utilized two active-intervention groups: a mindfulness training group and a concentration training group. The concentration training group did not utilize a mindfulness component and instead employed principles of cognitive behavior therapy (Krowatschek et al., 2007; Krowatschek et al., 2011). This group was removed from analyses as it was too different from the targeted intervention.

When more than one instrument is used to measure outcome variables, double-counting occurs and the resulting effect sizes are correlated. This occurs because the effect sizes are calculated using the same sample. Harrer and colleagues (2022) recommend two methods to resolve this problem. First, data based on all reported instruments can be interpreted if using a "three-level" meta-analytic model. Second, one instrument can be selected per study using a pre-determined hierarchy of instruments. This hierarchy should be based on the best reflection of the research question(s) or on instrument reliability. In the current study, a pre-determined hierarchy of instruments was referenced when coding the available articles. The current study introduced research questions concerning attention, working memory, and cognitive flexibility. The pre-

determined hierarchy of instruments was created by first considering a hierarchy of attention/executive functioning skills. If more than one instrument was used attention measures were prioritized because attention is a primary skill required for performance on a variety of assessments and tasks (Knudsen, 2007). When considering working memory and cognitive flexibility tasks, no clear skill-based hierarchy was present. Thus, when a study used both cognitive flexibility and working memory tasks, the test-retest reliability of each instrument was evaluated. The instrument with the highest test-retest reliability was included in the meta-analysis.

Of the eight primary articles identified, three utilized multiple instruments to measure attention and/or executive functioning. Wimmer and colleauges (2016) and Kiana and colleagues (2017) included measures of attention in addition to measures of either cognitive flexibility or working memory. As indicated by the pre-determined hierarchy, the measures of attention were selected for inclusion in this meta-analysis. Finally, Lassander and colleagues (2020) measured working memory using the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV) Digit Span task which has a reported test-retest reliability of 0.83-0.89 (Flanagan et al., 2010). Lassander and colleagues (2020) also measured cognitive flexibility with the Delis-Kaplan Executive Function System (D-KEFS) Trail Making Test Switching condition and Verbal Fluency Test switching condition, which have a reported test-retest reliability of 0.38 and 0.52, respectively (Delis et al., 2001). The WISC-IV Digit Span task was selected for inclusion in this meta-analysis as it had the highest reported test-retest reliability.

Effect Size Calculation

Prior to calculating effect sizes, pooled standard deviations were calculated using sample sizes and standard deviations for each group. Effect size calculations were completed by

computing Cohen's *d* using means and pooled standard deviations (SD) when available. Effect sizes for remaining studies were calculated using available statistics (i.e., *F, t* or *r*) and were converted to Cohen's *d*. Hedge's g was then calculated in order to compute the standard error for each effect size (Pigott et al., 2021). Analyses were completed using R Version 4.1.0 and R-Studio 1.4.1717 for MacOS.

A random-effects model was used due to a lack of equivalence between studies included in this meta-analysis. A random-effects model accounts for two sources of variation: sampling variance and between-study variance (Pigott et al., 2021). For example, this model accounts for the understanding that study participants and interventions differ and in turn impact the results of each study. Results are considered heterogenous when using a random-effects model, so it is assumed that the effect will vary between studies depending on study characteristics and variables. To determine the magnitude of the effect, an overall effect size is computed by calculating the inverse of the variance (Borenstein, 2009; Hedges & Vevea, 1998). Confidence intervals were also computed to test the significance of effects. (Pigott et al., 2021). Confidence intervals were used to determine the range of potential population means (Lipsey & Wilson, 2001).

Homogeneity Analysis

The use of a random-effects model indicates that considerable between-study heterogeneity was expected (Harrer et al., 2022). Heterogeneity analysis was conducted by computing a Q test using the calculated effect size values and their weights (Pigott et al., 2021). A *Q* test does not determine the magnitude of the variation or whether the observed dispersion is authentic or illegitimate. To determine the magnitude of the variation, absolute between study variance (τ^2) was calculated (Pigott et al., 2021). The current study used the Restricted

Maximum Likelihood estimator (Viechtbauer, 2005) to estimate τ^2. Another statistic used to determine between-study heterogeneity, based on the *Q* test, is the Higgins and Thompson's I^2 statistic (Higgins & Thompson, 2002). Computation of I^2 provides the percentage of variability in the reported effect size that cannot be attributed to sampling error. Meta-analytic guidelines indicate that when I^2 is greater than 50%, results should be assessed for outliers or influential cases (Harrer et al., 2022).

Moderator Analysis

To assess the relation between a dependent variable and a continuous variable, a meta-regression is used (Card, 2020). The length of intervention and mean age of students was analyzed as a moderator using a meta-regression. To assess the relation between a dependent variable and a categorical variable, a random effects ANOVA is used (Card, 2020). The gender of students is a categorical variable that was analyzed as a moderator.

Research Questions and Hypotheses

Research Question 1

How large are the effect sizes for school-based mindfulness studies?

Statistical Analysis. To answer this question, the mean effect sizes of all the outcome measures included in each study was used to compute an overall effect size. This was then averaged across studies.

Research Question 2

After adjusting for sample size, how large are the effect sizes related to increasing student attention?

Statistical Analysis. To answer this question, a weighted mean effect size was calculated using outcomes from three studies and homogeneity of effect sizes was tested.

Research Question 3

After adjusting for sample size, how large are the effect sizes related to increasing student working memory?

Statistical Analysis. To answer this question, a weighted mean effect size was calculated using outcomes from two studies and homogeneity of effect sizes was tested.

Research Question 4

After adjusting for sample size, how large are the effect sizes related to increasing student cognitive flexibility?

Statistical Analysis. To answer this question, a weighted mean effect size was calculated using outcomes from three studies and homogeneity of effect sizes was tested.

Research Question 5

How much do the effect sizes from school-based mindfulness interventions differ based on the length of the implemented intervention?

Statistical Analysis. To determine whether length of intervention is a moderator between school-based mindfulness intervention and overall effect size, a meta-regression was completed on 7 studies that included the length of intervention.

Research Question 6

How much do the effect sizes from school-based mindfulness interventions differ based on the age of students?

Statistical Analysis. To determine whether length of intervention is a moderator between school-based mindfulness intervention and overall effect size, a meta-regression was completed on 5 studies that included the mean age of students.

Research Question 7

How much do the effect sizes from school-based mindfulness interventions differ based on the gender of students?

Statistical Analysis. To determine whether gender is a moderator between school-based mindfulness intervention and overall effect size, a random effects ANOVA was completed on 6 studies that included the gender of participants.

Chapter IV: Results

Study Characteristics

A summary of the study characteristics is presented in Table 4.1. The 8 included studies were published between 2005 and 2020 and contain a total of 822 participants. Seven of the studies are journal articles while the remaining article is a dissertation. Only one study did not use random assignment. Three of the studies utilized a waitlist control group, two utilized an active control group (e.g., social responsibility or relaxation training program), and three utilized a passive control group). As mentioned previously, two studies had more than two groups which resulted in either the combination of groups or removal of groups.

Table 4.1

Summary of Study Characteristics Grouped by Control Type

Study	Publication Type	Control Type	Effect Size*
Flook et al., 2015	Journal	Waitlist	0.352
Schonert-Reichl et al., 2015	Journal	SR	0.243
Lassander et al., 2020	Journal	RT	0.119
Kiani et al., 2017	Journal	Waitlist	0.168
Wimmer et al., 2016	Journal	Passive	0.297
Salazar, 2017	Dissertation	Passive	0.07
Napoli et al., 2005	Journal	Passive	0.598
Quach et al., 2016	Journal	Waitlist	0.377

Note. *Hedge's g. SR=Social Responsibility Program; RT=Relaxation Training; CF=Cognitive Flexibility; WM=Working Memory

Study-level demographic data are presented in Table 4.2. One study included subjects with a specific clinical diagnosis (e.g., ADHD). More than half (63%) of studies reported the average age of participants. Fewer studies reported information on the ethnic backgrounds of participants. Of the 8 studies, most did not report information regarding ethnicity. Of the three studies that did, most (67%) reported samples that had a majority of Caucasian participants. The remaining study that reported ethnicity had a Hispanic majority. Of the five studies that reported information regarding gender, two had close to 50% female/male participation, two just over 30% male participation, and one had exclusively female participation.

Table 4.2

Study Level Demographic Data

Study	N	Mean Age	Female N	Male N	% Caucasian	Country	Clinical Diagnosis
Flook et al., 2015	67	4.7	34	33	58.8	US	n/a
Schonert-Reichl et al., 2015	99	10.24	n/a	n/a	n/a	Canada	n/a
Lassander et al., 2020	131	n/a	n/a	n/a	n/a	Finland	n/a
Kiani et al., 2017	30	n/a	30	0	n/a	Iran	ADHD
Wimmer et al., 2016	34	10.8	18	16	n/a	Germany	n/a
Salazar, 2017	95	15.8	65	30	85.3	US	n/a
Napoli et al., 2005	194	n/a	n/a	n/a	n/a	US	n/a
Quach et al., 2016	172	13.2	114	58	1.7	US	n/a

The average length of intervention sessions was 54.4 minutes (SD = 22.75, range 30 to 90 minutes). The average number of sessions was 23.5 (SD = 27.72, range 8 to 90). Two studies used a specific, manualized mindfulness intervention (e.g., MindUp and Attention Academy) and two studies used adapted manualized interventions (e.g., adapted MBSR). The remaining studies utilized interventions with various mindfulness components. A summary of intervention components is presented in Table 4.3.

Table 4.3

Intervention Data by Study

Study	Manualized Intervention	Targeted skills
Flook et al., 2015	--	Attention training, emotional regulation, kindness practices
Schonert-Reichl et al., 2015	MindUp	Executive functioning/self-regulation, social-emotional understanding, and positive mood
Lassander et al., 2020	--	Guided meditation and relaxation exercises
Kiani et al., 2017	--	Attention training, mindful breathing, mindfulness of body sensations/movement, and mindful listening
Wimmer et al., 2016	Adapted MBSR	Sitting meditation and body scans
Salazar, 2017	--	Mindful breathing, meditation, and yoga
Napoli et al., 2005	Attention Academy	Attention training, mindful breathing, yoga, body scan, aromatherapy, awareness practices
Quach et al., 2016	Adapted MBSR	Meditation, breathing, body scan, yoga

Analyses of Outcome Measures

The 8 studies each contributed one averaged effect size after corrections to address the unit-of-analysis problem. Each study reported pre-/post-test results using a measure of attention, working memory, or cognitive flexibility. Across the 8 studies, the random effects weighted average effect size was d=0.303 (p=0.0037, $CI_{95\%}$ 0.136 to 0.472). Effect size estimates ranged from d=0.07 to d=0.598. The test of homogeneity indicates that the differences between the articles is not beyond what would be expected by chance (Q=6.55, p=0.48). The heterogeneity between studies was found to be low (τ^2=0.01, $CI_{95\%}$ 0 to 0.08; I^2=0%, $CI_{95\%}$ 0 to 67.6).

Analyses were also completed to determine the random-effects average effect size based on comparison type. The random-effects average effect size was d=0.336 ($CI_{95\%}$ 0.104 to 0.567, k=3) for studies with a waitlist control group, d=0.354 ($CI_{95\%}$ -0.377 to 1.085, k=3) for studies with a passive control group, and d=0.174 ($CI_{95\%}$ -0.608 to 0.955, k=2) for studies with an active control group. The studies with waitlist and passive control groups were combined to determine the effect size for all control groups that were not engaged in an alternative intervention. The random-effects average effect size for waitlist and passive control groups was d=0.36 ($CI_{95\%}$ 0.136 to 0.586, k=6).

Mean Effect Sizes by Outcome Type

Effect sizes were generated by outcome type (e.g., attention, working memory, and cognitive flexibility). See Table 4.4 for a summary of the mean effect sizes by outcome type. Studies measuring the effect of mindfulness on attention had the most robust finding (d=0.51), a moderate effect size. Regarding studies that measured attention, the test of homogeneity indicates that the differences between the articles are not beyond what would be expected by chance (Q=1.48, p=0.49). The heterogeneity between studies was found to be low (τ^2=0.002,

$CI_{95\%}$ 0 to 1.853; I^2=0%, $CI_{95\%}$ 0 to 89.6). Regarding studies that measured working memory, the test of homogeneity indicates that the differences between the articles are not beyond what would be expected by chance (Q=0.42, p=0.81). The heterogeneity between studies was found to be low (τ^2=0.291, $CI_{95\%}$ 0 to 0.29; I^2=0%, $CI_{95\%}$ 0 to 89.6). Regarding studies that measured cognitive flexibility, the test of homogeneity indicates that the differences between the articles are not beyond what would be expected by chance (Q=0.09, p=0.77). The heterogeneity between studies was found to be low (τ^2=0; I^2=0%).

Table 4.4

Mean Effect Sizes by Outcome Type

Outcome	Assessment	Mean ES	95% CI		*k*
			Lower	Upper	
Attention	CPT– 3 (omissions) Vigilance Test (misses) TEA-Ch (selective attention)	0.51	0.018	1	3
Working Memory	WISC-IV (digit span) AOSPAN	0.147	-0.074	0.368	3
Cognitive Flexibility	NIH Toolbox DCCS task Flanker task	0.276	-0.359	0.912	2

Note. ES=Effect Size; CPT-3=Conners' Continuous Performance Test, Third Edition; TEA-Ch=Test of Everyday Attention for Children; WISC-IV=Wechsler Intelligence Scale for Children, Fourth Edition; AOSPAN=Automated Operation Span Task; DCCS=Dimensional Change Card Sort

Moderator Analyses

Length of Intervention

To determine whether length of intervention is a moderator between school-based mindfulness intervention and overall effect size, a meta-regression was completed on 7 studies that included the length of intervention. Results indicated that the length of intervention did not have a significant effect on effect size.

Age of Students

To determine whether the mean age of participants is a moderator between school-based mindfulness intervention and overall effect size, a meta-regression was completed on 5 studies that included the mean age of students. Again, results indicated that the mean age of participants did not have a significant effect on effect size.

Gender of Students

There was an attempt to run a random effects ANOVA on 6 studies that included the gender of participants to determine whether gender is a moderator between school-based mindfulness intervention and overall effect size. However, the sample was too small to interpret results.

Chapter V: Discussion

The promotion of social-emotional development is a task for which schools have increasingly become responsible. Thus, schools have begun to implement a variety of curricula and interventions to support students' social-emotional functioning. Several popularized mindfulness interventions for academic settings have been created and published. The purpose of mindfulness is to make individuals more aware of themselves and their environment. Children learn to be more aware of their own emotions, others' emotions, and even physical actions such as breathing and eating (Thompson & Gauntlett-Gilbert, 2008).

Although there is empirical evidence for the use of MBIs with adult populations, less research is available concerning the use of MBIs with children and adolescent populations. Some researchers and clinicians suggest that children and adolescents are not developmentally able to complete the cognitive tasks required of mindful practices (Maynard et al., 2017). In contrast, some research indicates that children can benefit from mindfulness in ways similar to adults (Davis, 2012; Hooker & Fodor, 2008). Due to the abstract nature of some mindfulness or meditative practices, adaptations may be necessary to ensure interventions are developmentally appropriate. Initially, adaptations to evidence-based mindfulness interventions such as MBSR and MBCT were made (Sibinga et al., 2013; Segal et al., 2002). More recently, mindfulness research has focused on school-based interventions rather than on clinical therapeutic interventions. School-based mindfulness interventions may be more beneficial than clinical interventions as they can reach more children (Webster-Stratton & Reid, 2010) and may offer an increased chance for generalization to daily activities.

The evidence-base for school-based mindfulness programs continues to develop; nonetheless, several programs have reported favorable outcomes for students. Studies show that

teaching mindfulness to children may have a positive effect on behavior (Bakosh et al., 2015; Hooker & Fodor, 2008; Semple et al., 2010; Shomaker et al., 2017), social-emotional development (Hooker & Fodor, 2008), emotional regulation (Broderick & Metz, 2009; Metz et al., 2013), and mental health (Edwards et al., 2014; Semple et al., 2010). Although school-based mindfulness curricula differ in approach and anticipated outcomes, previous meta-analyses of school-based mindfulness show favorable effects on measures of cognition and social-emotional skills (Maynard et al., 2017; Zenner et al., 2014). Several studies also focus on the effect of mindfulness practices on executive functions specifically (Butzer et al., 2015; Flook et al., 2010; Flook et al., 2015; Napoli et al., 2005; Parker et al., 2014; Semple et al., 2010; White, 2012).

As previously mentioned, developed EF skills allow individuals to process perceptions, thoughts, emotions, and behaviors in a purposeful, goal-driven, and organized way (McClosky et al., 2009), skills that are directly relevant to mindfulness. However, although mindfulness practice heavily relies on executive functioning skills, examination of the overall effect of school-based MBIs on the direct assessment of executive functions is minimal. The current study aimed to determine the overall effect of school-based mindfulness interventions on students' attention and executive functioning by evaluating performance on direct measures of attention and executive functioning. This chapter describes the results of the analyses as they relate to the research questions and hypotheses, and findings reported in the existing literature. Finally, a discussion of implications, limitations, and recommendations for future research are presented.

Summary of Findings

Results suggest that school-based mindfulness interventions have an overall positive, small-to-moderate effect (d=0.303) compared to control conditions. That is, students who participated in school-based mindfulness interventions experienced improvements in attention

and executive functioning 30.3% of one standard deviation better than students who did not receive mindfulness training. Compared with a waitlist or passive control group, school-based mindfulness interventions had a positive, small-to-moderate effect (d=0.36). Compared to an active control group, school-based mindfulness interventions had a positive, small effect (d=0.174).

School-based mindfulness interventions effectively improve student performance on attention and executive functioning tasks, particularly compared to no intervention at all. However, as noted above, findings indicate that when students in the control group engaged in an alternative intervention, the effect of school-based mindfulness training on attention/executive functioning was more negligible. For example, the current study examined the effect compared to alternative interventions such as a social responsibility program (Schonert-Reichl et al., 2015) or relaxation training (Lassander et al., 2020). One interpretation of this finding is understood by looking more closely at the studies that used active control groups.

Schonert-Reichl and colleagues (2015) compared mindfulness training to "behavior as usual (BAU)." This study took place in British Colombia; thus, BAU was represented by a social responsibility program. This program was created per British Colombia's Ministry of Education guidelines because social responsibility was included as a performance standard for students starting in 2001 (Schonert-Reichl et al., 2015). Students learned skills such as contributing to the educational community, problem-solving, valuing others' differences, treating others with respect/fairness, and understanding civic rights and responsibilities. Although this program does not include a mindfulness component, several skills targeted by the social responsibility program are standard components of mindfulness interventions. For example, it is not uncommon for mindfulness interventions to teach skills related to problem-solving, non-judgment of others, and

kindness/respect. Furthermore, Lassander and colleagues (2020) included relaxation training as an active control. Although the authors emphasize that mindfulness and relaxation training focuses on developing different skills, relaxation training is often a component in mindfulness interventions. Thus, when considering the adoption of a school-based mindfulness curriculum, schools should first evaluate programs that are already in place.

Effects on Attention and Executive Functioning

Although school-based mindfulness interventions often directly target a wide variety of skills, mindfulness training relies heavily on attention and executive functioning skills. McClosky and colleagues (2009) indicate that well-developed executive functioning skills are essential when processing perceptions, thoughts, emotions, and behaviors. As noted above, participation in mindfulness training has a positive, small-to-moderate effect on students' attention, working memory, and cognitive flexibility. When evaluated separately, participation in school-based mindfulness training has a moderate positive effect on student attention (d=0.51) and only a small positive effect on working memory (d=0.147) and cognitive flexibility (d=0.276). This finding is interpreted by examining the mindfulness interventions and targeted skills for each study. Of the studies that measured attention, two out of the three specifically report attention training as a targeted skill of the mindfulness intervention (Kiani et al., 2017; Napoli et al., 2005). None of the mindfulness interventions specifically target the other outcomes variables of working memory and cognitive flexibility. Attention to specific stimuli was explicitly taught in many of the studies. It was anticipated that this skill would be the most impacted by participation in mindfulness training. Notably, cognitive flexibility and working memory rely heavily on attention ability, as these tasks cannot be successfully completed if the participant cannot first pay attention to the stimuli.

Comparisons with Existing Analyses

The current study adds to the literature on school-based mindfulness interventions. First, only two previous meta-analyses were conducted to evaluate MBIs delivered in school settings (Zenner et al., 2016; Maynard et al., 2017). Zenner and colleagues (2014) included articles published before 2012, while Maynard and colleagues (2017) included articles published between 1990 and 2015. Therefore, the current study included four studies that were not included in previous meta-analyses examining school-based mindfulness. Additionally, this is the first investigation of the effect of school-based mindfulness on direct assessment of attention and executive functioning skills, as other meta-analyses have examined broad constructs, outpatient populations, or outcomes measured by rating scales (Zoogman et al., 2015; Klingbeil et al., 2017; Dunning et al., 2019; Zenner et al., 2014; Maynard et al., 2017). These differences from previous studies are essential because limiting the current study to only include direct assessment rather than rating scales of behavior allows us to focus on potential neurocognitive effects of school-based mindfulness interventions. Previous evidence shows that participation in mindfulness training alters the brains and cognitive functioning of adults, as found through neuroimaging (Zsadanyi et al., 2021). Although it is not feasible to conduct neuroimaging to assess the effectiveness of a school-based intervention, evaluating potential neurocognitive effects assumed to be impacted by mindfulness practices is an important place to start.

The current meta-analysis utilizes consistent statistical procedures compared to the two previous meta-analyses completed with school populations. However, one distinct difference in meta-analysis design was apparent. The current meta-analysis carefully addressed the unit-of-analysis problem. That is, the current study ensured that populations in the included studies were not subject to "double counting." However, Zenner and colleagues (2014) and

Maynard and colleagues (2017) included several measures within the same construct and did not report any measures taken to avoid this design flaw. Without addressing this concern, the core assumption of independence of effect sizes is violated (Higgens et al., 2019; Harrer et al., 2022), meaning that the effect sizes are correlated because they are calculated using the same sample. As addressed previously, the current study addressed this concern systematically, as recommended, to ensure that this double-counting did not occur (Harrer et al., 2022).

As noted above, the current study varied greatly from the two previously published meta-analyses conducted to evaluate school-based mindfulness intervention. For example, both Zenner and colleagues (2014) and Maynard and colleagues (2017) included broad constructs that were not well defined. Zenner and colleagues (2014) included a measure of creativity in their cognitive domain along with direct and indirect measures of attention. Maynard and colleagues (2017) included indirect and direct assessments of attention and cognitive flexibility in their broad cognitive construct. Consistent with these differences, the estimated effect size of the current study differs from those reported by previous analyses. Zenner and colleagues (2014) report a large, positive effect of school-based mindfulness interventions on measures of cognition (d=0.68), while Maynard and colleagues report a small, positive effect (d=0.25). Thus, at this time, a general statement regarding the effectiveness of mindfulness-based interventions on cognition cannot be made, as effects may range from small to large.

Comparisons with Studies Lacking Control Conditions

Given the innate design differences between empirical studies that include a control condition and those that do not, two articles that met inclusion criteria were excluded due to a lack of control comparison. However, outcomes for each study are reviewed here.

Worth (2013) utilized a pre-post design to determine the effects of an 8-week Mindful Awareness Practices (MAPs) for ADHD intervention on the executive functioning of middle school students. Outcome measures consisted of the Stroop Color and Word Test: Children's Version (SCWT-C), Trail Making Test (TMT), and Conners 3 parent- and teacher-report forms. Thus, an effect size for the current study was computed using the pre-post data from the TMT, a measure of cognitive flexibility. This measure was selected because the SCWT-C is a measure of inhibition and the Conners 3 forms are not a direct assessment. Cohen's *d* was computed using the reported means and standard deviations. Overall, the MAPs for ADHD intervention on a measure of cognitive flexibility had a large, positive effect (*d*=1.196).

Grosswald and colleagues (2008) utilized a pre-post design to determine the effects of school-based transcendental meditation training to reduce symptoms of ADHD. Outcome measures consisted of the Achenbach Child Behavior Checklist (CBCL), Achenbach Youth Self-Report (YSR), Cognitive Assessment System (CAS) Expressive Attention, Delis-Kaplan Executive Function System (D-KEFS) Verbal Fluency Test, Tower of London, and Connor's CPT-II. The current study evaluated the effect size reported for the D-KEFS Verbal Fluency Test, a measure of cognitive flexibility. This measure was selected because the CBCL and YSR are not direct assessments, the CAS is a measure of inhibition, and results from the Tower of London and Connor's CPT-II were excluded. Overall, transcendental meditation training had a small-to-moderate, positive effect (*d*=0.4; Grosswald et al., 2008).

Although the current study could not include these results in analyses, important implications can be drawn from their findings. Both studies focused their intervention efforts on students with ADHD diagnoses and found moderate to large effects on cognitive flexibility. The current study only found small effects of mindfulness on measures of cognitive flexibility.

Notably, the current study did not focus on clinical populations. Thus, mindfulness may have a more significant impact on the cognitive flexibility of students diagnosed with a disorder of attention and executive function such as ADHD.

Implications for Practice

Mindfulness has become a "buzzword" in educational settings. However, empirical information regarding the adoption of school-based mindfulness interventions continues to grow and evolve. Given the current state of the research, several positive changes in student functioning are possible when mindfulness skills are introduced. Although positive effects are noted, schools should carefully review school-based mindfulness interventions before adopting a school-wide program.

Manualized mindfulness interventions vary greatly in terms of intervention length, session length, and targeted skills. Thus, school personnel should first establish social-emotional goals and subsequently select an intervention with lessons that can help address those goals. In general, the adoption of social-emotional curriculums in schools has been on the rise as schools have become increasingly responsible for addressing the development of non-academic skills. Therefore, as noted above, schools should first evaluate any programming that is already in place when considering the adoption of a school-based mindfulness curriculum. A separate mindfulness intervention may not be warranted or beneficial if similar skills are being targeted through other interventions, programs, or curricula. However, mindfulness may be a useful addition to any classroom, as individual mindfulness skills (e.g., mindful breathing/meditation) are easy to practice and do not take much time. Therefore, if schools already have functional school-wide social-emotional programming, the adoption of a specific mindfulness intervention may not be necessary for several reasons.

Mindfulness is an internalized skill that requires long-term practice for both the mindfulness facilitator and the trainee. Just as with any social-emotional skill, modeling is a critical component of instruction. Therefore, teachers or school personnel who do not buy in to mindfulness may struggle to model mindful behaviors and facilitate student training. Additionally, because mindfulness requires long-term practice, adoption of manualized interventions that do not span the school year may not be best. It may be more beneficial for teachers to adopt daily, brief mindfulness practices across the entire school year. Core mindfulness skills such as breathing exercises, guided meditations, and body scans would require no more than five to 10 minutes per day. Furthermore, results of this study indicate that length of intervention was not found to be a moderator for the effect size of mindfulness-based interventions, Thus, brief, daily practice may be the best course of action when introducing a school-wide, tier 1 mindfulness intervention.

Although introduction of a school-wide manualized intervention may not be warranted if a sufficient social-emotional curriculum is in place, mindfulness-based interventions should be considered for tier 2 or tier 3 levels of support in MTSS frameworks. Introducing structured mindfulness-based curricula with small groups or individual students would allow for a more targeted intervention. Introducing more extensive mindfulness practice with small, targeted groups would also allow for schools to monitor any negative effects of mindfulness that may impact children with anxiety or trauma symptoms.

In summary, mindfulness training has the potential to positively impact students' behavioral and emotional functioning. Teachers should be encouraged to consider the inclusion of mindfulness practices in their classrooms to supplement social-emotional intervention. When schools do not already have a functional school-wide social-emotional curriculum, mindfulness

interventions should be considered to determine if they would meet the established social-emotional goals.

Limitations

Study Design

Meta-analyses are limited by the quality of studies that are included in analyses (Card, 2020). Therefore, due to flaws in the designs of the included studies, the current study results are limited. The quality of the included studies was examined by evaluating design-related variables such as random assignment, rate of attrition, the similarity of participants at baseline, intervention fidelity, and report of power analyses.

Of the eight included studies, four utilized a randomized controlled design (Flook et al., 2015; Schonert-Reichl et al., 2015; Lassander et al., 2020; Quach et al., 2016). Three additional studies utilized random assignment but were not classified as randomized controlled designs (Kiani et al., 2017; Wimmer et al., 2016; Napoli et al., 2005). Two studies reported that they randomly assigned students to the intervention or control group by classroom (Flook et al., 2015; Schonert-Reichl et al., 2015), while one reported that they randomly assigned students by school (Lassander et al., 2020). Salazar (2017) did not randomly assign participants. Instead, students either signed up for a typical gym class or a mindful yoga elective class. Only one study reported analyses that indicated similarity of participants at baseline (Schonert-Reichl et al., 2015). Only half of the included studies reported information related to attrition. Both Quach and colleagues (2016) and Salazar (2017) reported that they did not lose any participants, while Lassander and colleagues (2020) and Napoli and colleagues (2005) lost 15 and 34 participants, respectively. Only three studies included measures of intervention fidelity (Wimmer et al., 2016; Salazar, 2017; Quach et al., 2016). All three studies reported appropriate intervention fidelity. Finally,

only two studies included power analyses (Salazar, 2017; Quach et al., 2016), and both indicated that they included more participants than were required to have statistical power.

Measurement of Outcome Variables

Just as the quality of the included studies limited the current meta-analysis, results were also limited by the assessments that were used to measure the outcome variables. In general, measures used to evaluate attention and executive functioning have adequate positive predictive power and poor negative predictive power (Grodzinsky & Barkley, 2010). Positive predictive power refers to the probability that a positive result indicates the presence of a disorder, while negative predictive power refers to the probability that a negative result indicates the absence of a disorder (LaMorte, 2020). Thus, when a neuropsychological assessment of attention/executive functioning has good positive predictive power and results indicate a concern with attention or executive functioning, there is a reasonable probability that this poor performance is related to true deficits in those skills. However, adequate performance on measures with poor negative predictive power cannot be interpreted to mean that there are no deficits in attention/executive functioning or absence of an attentional disorder. Although the purpose of this study was not to diagnose concerns related to attention or executive functioning, the general poor negative predictive power of many neuropsychological assessment tools is essential to consider in this context.

Small Sample

Due to the small sample size of studies that have evaluated the effect of school-based mindfulness interventions on direct assessment of attention/executive functioning, the range of analyses was limited. If a greater range of studies were available analyses regarding externalizing disorders (e.g., ADHD) or special education disability category (e.g., Other Health Impairment)

could have been conducted. Additionally, moderator analyses may have been more robust with a bigger sample size. Analysis of categorical moderators was not able to be completed due to the small sample size available.

Suggestions for Future Research

The current study required an extensive review of the available literature on school-based mindfulness interventions and student attention and executive functioning. Therefore, several important recommendations about future directions for mindfulness intervention in schools and the interpretability of studies in this area can be made.

First, given the broad range of available mindfulness interventions, efforts should be made to clearly communicate the treatment components that are being delivered. Although several studies did indicate the specific intervention that was used and listed targeted skills, others did not provide a comprehensive description of the chosen intervention. In general, a considerable limitation of mindfulness research is the inconsistent treatment that is being provided. This inconsistent treatment makes it difficult to generalize results across studies and complicated for consumers to determine the benefits of one curriculum over another. A clear definition of the intervention being evaluated can provide consumers with valuable information and can advance the study of mindfulness.

Second, consumers would benefit from transparent reporting of participant characteristics. Several studies did not adequately report participants' demographic information (e.g., mean age, gender, grade). Furthermore, when demographic information was available, it was clear that an overwhelming majority of participants were Caucasian and female. Efforts should be made to broaden the demographic scope of school-based mindfulness intervention and research to enable more generalizable results. Additionally, many studies appear to approach

mindfulness from a perspective of school-wide, tier one intervention. Further analysis regarding mindfulness intervention with targeted populations, tier two and three, was not able to be completed due to a lack of available studies. It would be beneficial in the future to determine whether mindfulness has a more significant effect on children with identified clinical diagnoses (e.g., ADHD) or special-education eligibility categories (e.g., Other Health Impairment, Emotional Disturbance, etc.).

Finally, future meta-analyses should consider investigating constructs that are less broad in design. It is difficult to understand the actual effect of mindfulness intervention on various constructs because the available literature often focuses on broad constructs such as cognition. However, each analysis may define cognition differently and include outcome measures that do not clearly fit into the specified category. Additionally, when a study analyzes outcome measures that widely vary, such as including informant reports and direct assessments of students, it may be valuable to include separate analyses for each type of outcome measure. In this way, the externalizing behavior of students can be evaluated separately from the direct performance of neuropsychological functioning.

Conclusion

School-based mindfulness practices are one way to support the social-emotional development of students. Mindfulness teaches students to increase their attention of surroundings and internal experiences, and awareness of their thoughts and behaviors. While the evidence-base for mindfulness interventions in schools is ongoing there are several studies that show promising outcomes. The current study examined the effect sizes for school-based mindfulness studies in regard to increasing student attention, cognitive flexibility, and working memory. Results indicate an overall positive, small-to-moderate effect of school-based mindfulness

intervention on student attention and executive functioning. Schools should consider adding mindful components into pre-existing social-emotional curriculums and are encouraged to consider school-based mindfulness curricula as a social-emotional intervention when one is not already in place. Future research should work to clearly communicate the components of school-based mindfulness interventions. Additionally, future research should evaluate the benefit of using school-based mindfulness interventions with at-risk or special education students. Future meta-analyses would benefit from clear reporting of participant characteristics and investigation of narrow constructs relating to the behavioral and emotional functioning of students.

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Appendix A: Coding Manual

1. AUTHOR

Last name of first author

2. CODER

Who is the Coder?

1 = Sarah 2 = Research Assistant

3. YEARPUB

Year of Publication

4. PUBTYPE

Publication Type

1 = Journal Article 2 = Dissertation 3 = Unpublished report

5. COUNTRY

What Country was the study conducted in?

1 = US 2 = Canada 3 = Europe 4 = Asia 5 = Other

6. CONTROL

Was a control group used?

1 = Yes 2 = No

7. RAND_ASSIGN

Were the participants randomly assigned to groups?

1 = Yes 2 = No 99 = Not Indicated

8. SAMP_SIZE

What is the total sample size at the start of study?

9. SAMP_SIZE_TREAT

What is the treatment group sample size at the start of the study for the first treatment group?

10. SAMP_SIZE_CONTR

What is the control group sample size at the start of the study for the first control group?

11. SAMP_SIZE_POS

What is the number of participants at post-test (include controls)?

12. FOLLOWUP

Was there a follow-up included?

1 = Yes 2 = No

13. FOLLOW_LENGTH

If yes, what is the length of time (in weeks) to follow-up?

Enter # of weeks or 99 = Not Indicated

14. SAMP_SIZE_FOL

What is the number of participants at follow up (include controls)?

15. BETWEENGROUP

Is there a between group comparison?

1 = Yes 2 = No 99 = Not Indicated

16. WITHINGROUP

Is there a within group comparison?

1 = Yes 2 = No 99 = Not Indicated

17. INTERVENTION_LENGTH

Total length of intervention in weeks

18. SESSION_NUM

Total number of sessions

19. SESSION_DURATION

Duration of each session in minutes

20. MINDFULNESS_SESSION

Total number of sessions focused on mindfulness skills

(Keywords: breathing, relaxation, yoga, attention, meditation, mindful)

21. INTER

Type of Intervention

1 = Attention Academy 2 = Learning to BREATH 3 = MindUP 4 = Master Mind

5 = Other 99 = Not Indicated

22. AGEMEAN

Mean age of student sample initially recruited/began the study

23. AGESTDEV

Standard deviation of student sample age for those recruited/began study

24. AGERANGE

Range of student ages in sample

25. ETHNICITY_STUDENT

What is the ethnicity of the students?

1 = Greater than 60% Caucasian 2 = Greater than 60% Black 3 = Greater than 60%

Hispanic 4 = Greater than 60% Asian 5 = Mixed, none more than 60% 6 = Mixed,

cannot estimate proportion 99 = Not Indicated

26. GENDER_STUDENT

1 = Less than 5% male 2 = Between 5% and 50% male 3 = 50% male

4 = Between 50% and 95% male 5 = Greater than 95% male 99 = Not indicated

27. CLINICDIAG_STUDENT

Do the student participants have a clinical diagnosis?

1 = Yes 2 = No 99 = Not indicated

28. CLINICDIAG_NAME

What is the diagnosis of the students?

1 = Externalizing Disorder (e.g., ADHD) 2 = Internalizing Disorder (e.g., anxiety, depression) 3 = Combination of Externalizing and Internalizing Disorder 4 = Other

29. OUTCOME

Category of Outcome Construct

1 = Attention 2 = Cognitive Flexibility 3 = Working Memory

30. ESTYPE_DATA

Type of data effect size based on

1 = Cohen's D 2 = Hedges g 3 = Means and standard deviations 4 = τ value or *F* value and df 5 = chi-square 6 = Other

31. PAGENUM

Page number where effect size data found

32. TXS

Treatment group sample size at end of study

33. CGS

Control sample size at end of study for first control group

34. TXD1

Treatment group vs control Cohens d

35. TXD2

Pretest versus posttest Cohens d

36. CGMEAN

Control group pre-test mean

37. CGMEANP

Control group post-test man

38. CGMEANF

Control group follow-up mean

39. TXMEAN

Treatment group pre-test mean

40. TXMEANP

Treatment group post-test mean

41. TXMEANF

Treatment group follow-up mean

42. CGSD

Control group pre-test standard deviation

43. CGSDP

Control group post-test standard deviation

44. CGSDF

Control group follow-up standard deviation

45. TXSD

Treatment group pre-test standard deviation

46. TXSDP

Treatment group post-test standard deviation

47. TXSDF

Treatment group follow-up standard deviation

48. FVALU

F value from f test (post-intervention)

49. DFVALU

Degrees of Freedom for T or F test

50. TVALU

T value from t test

51. CHISQUARE

Chi-square value

52. RSQUARE

R^2 value from t test