Summer 2023

Executive Function & Self-regulation in Preschool Age Children: Mindfulness Intervention

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EXECUTIVE FUNCTION & SELF-REGULATION IN PRESCHOOL AGE CHILDREN: MINDFULNESS INTERVENTION

by

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ABSTRACT

Executive function is an umbrella term used in psychology to define a number of cognitive processes that are important for success in daily life. Both self-awareness, being able to focus one's thoughts and behavior, and self-regulation, being able to manage emotional and behavioral responses, are important components of executive function. Between three- and five-years of age, children begin developing such skills rapidly which are necessary for school readiness. This study recruited children participants from four local preschools to test for improvement in attention and self-regulatory skills. Two schools completed a mindful yoga activity for five consecutive days, while a second set of two schools completed a control gratitude activity. Children were measured pre- and post- activity on two executive function tasks. Data was analyzed using 2 x 2 mixed model ANOVAs, with group (intervention classrooms and control classrooms) analyzed between-groups and test phase (pre- versus post-test) analyzed as a repeated measure, with performance on Go/No-go task and Head-Shoulders-Knees-and-Toes (HSKT) tasks as the dependent measures. Results were predicted to align with previous work on mindfulness interventions, yet no significant interactions were found between test-phase and test-group. This current study provides this field a new opportunity for expansion in the use of short-term mindfulness interventions and preschool executive functioning. Future research could

continue to expand on short- and long-term implementation of such mindfulness intervention strategies by investigating further potential improved preschool executive functioning.

INDEX WORDS: Executive function, Self-regulation, Mindfulness and Self-awareness

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B.A., The College of Wooster, 2021

M.S., Georgia Southern University, 2023

A Thesis Submitted to the Graduate Faculty of Georgia Southern University in Partial Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

COLLEGE OF BEHAVIORAL AND SOCIAL SCIENCES

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Electronic Version Approved:
June 2023

ACKNOWLEDGMENTS

First and foremost, I would like to thank my advisor, Dr. Ty Boyer, whose patience, dedication, and curiosity has guided me on this journey to quality completion of this project. His dedication to his own work has sparked in me a desire to pursue my PhD at a respectable institution. Next, I would like to thank my committee members, Dr. Nicolette Rickert and Dr. Antonio Gutierrez de Blume, who took the time and effort to expand my project perspectives and general knowledge. It has been an honor to learn from all your expertise and I look forward to continuing to grow the seeds of your teachings. Likewise, I would like to thank Georgia Southern University, staff, Professors, friends, and peers alike, for their contribution to this project, as well as my education these past two years. Importantly, I want to highlight that I would not be here today had it not been for my partner, my family, extended family, teachers, and coaches, the heroes and role models who have likewise guided my academic journey.

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CHAPTER 1

INTRODUCTION

Purpose of Study

Executive function refers to cognitive processes such as working memory, attention, and inhibitory control. The most drastic change in executive function occurs during the preschool years (Garon et al., 2008). In infancy reflex and sensorimotor behaviors develop, which then begin to expand in these early preschool years into regulatory behaviors (Eisenberg et al., 2010). Children of this age become able to think and engage in rule-governed behavior using self-regulatory skills. Broomell and Bell (2022) conducted a study with a longitudinal design using various executive function tasks to show that it is possible to study executive function as early as toddlerhood which is prior to preschool and therefore could foster benefits to early effective intervention during these age ranges. Executive function is significantly related to learning ability in children (Bull et al., 2008), and longitudinal studies have shown that these processes critically contribute to literacy and mathematics (Blair & Razza, 2007). Melby-Lervag and Hulme (2013), suggested that there are large benefits to training younger children's executive function skills. Beginning in preschool, children can work to improve their executive functioning in anticipation of school readiness.

Inhibitory control is one facet of executive function that develops in early childhood. This is the ability to refrain from engaging in a behavior. This is related to self-control, the ability to behave in a manor appropriate for the context one is in. Both of these concepts fall under the term self-regulation, which can encompass behavior and emotions. Children with poor self-regulation risk emotional and behavioral developmental difficulties that could lead to challenges establishing positive relationships with teachers as well as peers (Eisenberg et al., 2010). In a

school setting, daily activities require children to use self-regulatory behaviors. For example, they learn to inhibit themselves from shouting out an answer to a question, and instead, wait their turn by raising a hand. It is essential for learning that students have the ability to use self-regulatory processes in order to attend to important new information, follow instructions, and stay on task. Children who have attentional difficulties may get distracted easily, may need more direction, or may be forgetful or appear unengaged (Savina, 2020). Fostering children's ability to focus on the task at hand and likewise inhibit undesired behavior in the classroom setting, is essential for later success in school. One way this can be implemented is through intervention practices.

Traverso et al. (2015) found that although executive function interventions with children have shown limited use in education settings, they show potential for enhancing children's self-regulation skills. The researchers used a control group that spent the day continuing regular kindergarten activities, while an intervention group spent part of the regular day enacting roles of characters on a story plot game (a form of sociodramatic play). The adults would explain the rules and facilitate the game when necessary. The roles of characters in the game were exchanged during observational test sessions and the children would be encouraged to regulate conflicts amongst themselves using the existing rules. The important aspect is that all efforts for self-regulation where praised during and after sessions. The children's adult aids would provide support to child's self-esteem and well-being as needed to help the children self-regulate. By guiding children as needed and fostering these supports, Traverso et al. (2015) showed that using group-based play activities integrated into an Italian kindergarten can be successful at building self-regulation in young children. Other studies have used alternative interventions successfully. Promoting self-regulation in a classroom can help these students stay on track and require less

direction from the teacher to refocus the child. Effective self-regulation trainings have been incorporated into the daily routine of the classroom instruction (Diamond & Lee, 2011). Likewise, students with signs of early academic challenges, and lower self-regulatory skills, are the ones who have been shown to benefit the most from these interventions (Diamond & Lee, 2011). These works show promise for the implementation of interventions in classrooms, as well as the importance of such executive function skills on school readiness.

Examining behavior regulation more specifically, three types of interventions have been used: movement-based activities, game-based activities, and mindfulness-based activities. For movement-based interventions, active outdoor recess has shown positive associations with motor inhibition (Becker et al., 2014), and at Head Start preschools that participated in creative dance, children were found to have fewer behavioral deviations with improved social competency (Lobo & Winsler, 2006). Movement activities improve attention capabilities and can easily be incorporated 10-15 minutes a day during classroom routine breaks, such as transitional periods between activities (Savina, 2020). Game-based interventions, such as music or play based games in circle time, can help motor inhibition in preschoolers (Schmitt et al., 2015). Similarly, a game-based intervention used at a school-readiness summer program showed benefits to self-regulation with later success in literacy and math skills (Duncan et al. 2018).

Finally, mindfulness-based interventions also show promise in improving self-regulation. The idea behind mindfulness is to build sustained attention by focusing on breathing and body movements in terms of the space and sensations one feels, as well as thoughts and feelings to establish a calming effect (Schöne et al., 2018; Malinowski, 2013). Having high arousal can negatively impact the ability to self-regulate, which is why early intervention, such as implementing mindfulness techniques to classroom curriculum, can aid children to lower arousal

and subsequently self-regulate better. The advancement of executive function research in general can help to provide insights into the links between executive function and general intelligence, especially with young children where developmental differences can be targeted for improvement early on (Blair et al., 2005).

CHAPTER 2

LITERATURE REVIEW

Executive Function

Executive function, or cognitive control, is a well cited umbrella term used in many subfields in psychological research. The term broadly refers to the cognitive processes that enable cognitive flexibility (i.e., using problem solving) and are building blocks for self-regulatory behaviors (i.e., the ability to adapt how one thinks and behaves). This ability is connected to cognitive control, a conscious, goal-directed, and deliberate neural process that is used to control thoughts, feelings, and actions (Zelazo & Carlson, 2012). It is important to note that cognitive control can be impaired for children with developmental differences such as in attention deficit hyperactivity disorder (Diamond et al., 2007), yet with the right support can still be improved through intervention trainings of working memory as seen in Klingberg et al. (2005) with adolescents and adults. In this study students were taught to self-regulate using cues and self-check-ins to monitor their own behavior as it related to their classroom goals, this being something that could be easily implemented into long-term curriculum. Another study working with slightly older children who have developmental disabilities, Wehmeyer et al. (2013), found success improving self-regulatory strategies in an educational setting implementing an intervention involving personalized programs crafted by three students and their special education teacher. Therefore, interventions geared towards executive function skills, benefit all children, especially those who may need it the most.

Again, executive function is a multi-faceted construct that overarches several cognitive processes, including self-regulation and inhibitory control, which is suppressing or altering thoughts, feelings, and actions. (e.g., Cepeda & Munakata, 2007; Kochanska et al., 1996;

Kochanska et al., 1997). Working memory is another facet of executive function, which is defined as briefly holding pieces of information in one's mind (e.g., Roman et al., 2014). In children, the development of executive function occurs during a prime stage of neural plasticity, around three to five years of age (Diamond, 2013). The environmental context a child is in can influence the development of these cognitive processes. Parents and teachers respectively represent key figures in promoting these skills, especially as they are the primary care individuals in a child's early life (Fay-Stammback et al., 2014). Different models of executive functioning show how the biological factors, neurocognitive development, and contextual processes all work together (Zelazo et al., 2013).

Another facet of executive function is cognitive flexibility (e.g., Carroll et al., 2016), which is defined broadly to encompass the ability to adapt to new or unexpected circumstances, which allows for adaptive responses to different situations (Ionescu, 2012), and is related to self-regulation. Executive function is connected to numerous other abilities that all develop rapidly during the first few years of life and interconnect. These include memory (i.e., retaining information), attention (i.e., focusing; e.g., Mulder et al., 2009), theory of mind (i.e., perspective taking; e.g., Hughes & Ensor, 2005), and self-regulation (e.g., Blair & Raver, 2015). Improving executive functioning takes cognitive effort and time to develop well into ones adulthood (Zelazo & Carlson, 2012). It can largely help children with long-term working memory, inhibitory control, and cognitive flexibility (Traverso et al., 2015), skills that are beneficial to social functioning. Creating a stimulating and accepting environment for children can help build these cognitive processes used for executive functioning (Diamond et al., 2007). As mentioned, executive function develops most rapidly in the preschool years which is why much research has focused on this time period (Diamond & Lee, 2011). This is a time of much brain plasticity

where many challenges arise for the child to practice and learn executive functioning skillsets (Zelazo & Carlson, 2012). It is therefore beneficial to promote executive functioning during preschool as there are a number of outcomes related to school readiness, like with math and literacy (Blair & Razza, 2007).

Self-regulation

Self-regulation is defined as one's ability to understand and manage emotional and behavioral responses to the world around oneself. Self-regulation begins in infancy when newborn babies physiologically regulate their eating and sleeping patterns (Robson et al., 2020). Toddlers work on self-regulation as they learn to manage behavior in social situations (Robson et al., 2020). The development of self-regulation depends on a number of aspects. These include temperament and the quality of parent-child interactions (e.g., Meuwissen, & Carlson, 2019), the quality of teacher-child interactions (e.g., Cadima et al., 2018), and the quality of the home/school environments (e.g., Montrov et al., 2016b). As with executive functioning, self-regulation is also a multifaceted construct that leads to different outcomes (Korucu et al., 2022).

An example of how this would portray in everyday life could be a three-year-old requesting to get ready for bed independently. This initiative shows a sense of ambition to accomplish the task that they set out to complete. A parent supporting this decision is giving the child a sense of autonomy and responsibility. In turn, this helps build self-confidence in the child. This likewise is important with teachers that provide close relationships with the children by supporting autonomy and the development of self-regulation, which in turn can also help build vocabulary as early as preschool (Cadima, et al., 2018). Children are more likely to be intrinsically motivated when using individually appropriate self-regulatory challenges at a school setting (Day et al., 2022). Self-regulation, with executive functioning, develops rapidly during

the preschool years, along with neural networks that involve executive function systems (Zelazo & Carlson, 2012). With this, there is malleability to these self-regulatory skills in the early years of schooling to middle childhood (Gunzenhauser et al., 2017), and should be promoted in such settings.

There are two main types of self-regulation that children are working to improve. First, emotional self-regulation is an individual's ability to recognize, initiate, avoid, maintain, or alter the expression of how they are feeling in a constructive manner. The regulation of an emotion can be difficult to identify in day-to-day social interactions. Emotion self-regulation can prevent an emotion as well as create the experience of one (Eisenberg & Spinard, 2004). Second, behavioral self-regulation is defined as an individual's ability to act and express themselves in an appropriate manor given the context. Behavioral self-regulation has been found to develop progressively over childhood, with rapid growth during preschool (Montroy et al., 2016a). Children who exhibit externalizing behavior problems per parent and teacher reports, tend to have a lower amount of attentional regulation and inhibitory control (both important to self-regulation), which leads them to be more impulsive (Eisenberg et al., 2001). The ability to inhibit or activate given behaviors is significant for the regulation of emotional expressions (Eisenberg, 2000). In Gunzenhauser et al. (2017) it was suggested that girls outperform boys in regard to behavioral self-regulation, inhibitory control, and cognitive flexibility (executive function tasks). However the difference in this gender gap does not widen in elementary school which suggests that there might be more of a benefit to looking at individual differences. Likewise, Kochanska et al. (2001) found that girls outperform boys with higher willingness and ability to self-regulate behavior.

Building on this ability to regulate, children have been found to prefer smaller and immediate rewards over larger and delayed rewards. The ability to wait for a larger reward that takes a longer period of time to receive has been well studied in young children and replicated (Mischel, 1974). This skillset is typically studied looking at children's abilities to delay such rewards with a delay-of-gratification task. Findings from this task, however, are nuanced, and, for instance, Principe and Zelazo (2005) found that three- and four-year old children's performance of the task varied with whether they were choosing a reward that would be bestowed to themselves or someone else. Both the ability to self-regulate and delay gratification are important in their own right for school performance, such as writing skills which require focused attention (Puranik & Li, 2022) and the prevention of behavior problems (Rademacher, 2022). So far, many models to study self-regulation have been created and Inzlicht (2021) suggests that they cannot be combined; however, the models that have been offered shed light on the need to further study underlying process to self-regulation over time, as well as expanding the knowledge of how emotions facilitate self-regulation.

Benefits & Outcomes of Self-regulation

It is of major importance to promote emotional and behavioral self-regulation in young children as it leads to positive adaptations as they transition into school. Essentially, by having children acquire the skills to self-regulate, they can benefit directly from being more prepared to engage with the process of learning (Blair & Diamond, 2008). Children who are unregulated and high in emotionality can be prone to behavioral or social problems (Eisenberg et al., 1995). The frequency of problem behaviors, such as low attentional control or low scores on behavioral tasks, is associated with low regulation in children. Many studies have primarily focused on successful school readiness (Korucu et al., 2022), academic competence and achievement (Blair

& Razza, 2007), and higher levels of pro-social behavior, like with the benefits of peer relationships and high levels of self-regulation in classrooms (Montroy et al., 2016b). Implementing strategies for self-regulation and the ability to practice self-control can lead children to grow into to happier, healthier, and wealthier law-abiding adults (Inzlicht, 2021)

The importance of studying self-regulation can also be applied to children who have disabilities, developmental delays, or are at risk for such as they tend to have lower engagement with classroom activities and lower levels of self-regulatory skills than typically developing children (Coelho et al., 2018). Further, children who were born preterm have lower emotional and behavioral self-regulatory skills by two and four years of age which builds another case for the need to intervene early on to benefit children for school readiness (Woodward et al., 2016). A recent systematic review by Day et al. (2022) suggested ultimately that children, even by the age at which they are entering preschool (i.e., three- or four-years of age), can feel competent, have autonomy, and relate through play-based activities. In order for successful implementations of interventions that aim to build self-regulatory behaviors and other executive function skills in three- or four-year old's, these feelings of competence and autonomy are necessary. Providing autonomy support to caretakers of preschoolers can also be a potential avenue for interventions to help promote self-regulation. Parents for example are able to implement behaviors that can be taught through brief demonstrations and practice with their child (Meuwissen, & Carlson, 2019). Building on other factors for interventions, a recent study by Loomis (2021), suggested that there is a need to incorporate sociodemographic risk into already existing frameworks for interventions. Sociodemographic factors can lead to difficulties in self-regulation as seen using a bidirectional model, looking at cumulative household adversity, and cumulative environmental adversity. This was one of the first studies to look at African American and Latino preschool

children which yielded support for the exploration of interventions that support self-regulation when there are feelings of fear (such as with communities of concern experiencing violence). This is further evidence for the promotion of school readiness using an intervention focused on self-regulation.

Mindfulness

The practice of mindfulness meditation originated in Asia with Buddhism and research into its effects has been carried out over the years with adults primarily in Eastern cultures, yet also in the last few decades in Western cultures. At the heart of Buddhism is the Buddha, who suggests one of the key elements to a noble path in life to end one's suffering and bring wisdom, is through the self-awareness of causes and sources of suffering to gain a form of self-enlightenment (Xiao et al., 2017). Essentially, the idea of reflecting on experiences in a higher-level form of awareness in the moment one is in (Zelazo & Lyons, 2011). This is typically known more broadly in popular Western culture as mindfulness, can lead to a higher levels of restfulness and calm with oneself and the environment. The concepts of attention, awareness, and attitude play major roles in the path to self-enlightenment through this form of self-awareness (Xiao et al., 2017). In clinical practice it has been proposed that mindfulness practices can be a way to intervene in mental health problems and bring about well-being (Xiao et al., 2017).

Since the 1980s, in Western cultures, the study on mindfulness has become of much scientific interest, including with children, and has more recently become the base for interventions in many applied fields such as stress treatments, sports performance, and education. Many such studies in education have focused on primary and secondary school settings (Greenberg & Harris, 2012). Those who have focused on preschool thus far focused primarily on social-emotional development, and the regulation of emotions and behavior (Berti & Cigala,

2022). With children, mindfulness often includes small group activities that aim to promote self-awareness (Zelazo & Lyons, 2011).

One key ability that influences attention (an executive function skill) is self-awareness. Self-awareness involves being sensitive to oneself in terms of space and time in an environment. In many ways, mindfulness encourages the skill of self-awareness (Berti & Cigala, 2022). During mindfulness tasks, the child may be asked to bring their attention back from other thoughts or experiences through conscious thoughts and calmed breathing. The goal is to work on reconnecting the child back to the task at hand, and away from undesired behaviors or emotions through the teachings and guidance of an adult who may already have learned such self-regulatory skills. As an example, consider a child who may be having a difficult time transitioning from one activity to the next or might be showing signs of frustration and unrestful behavior. Through a teacher's guidance, however, the child can learn to use mindfulness techniques, like refocusing his or her attention on breathing and becoming more emotionally and behaviorally calm.

One benefit to mindfulness is its ability to help encourage growth of prosocial behaviors by bringing the child’s attention to feelings and emotions so that they may be in touch with peers and likewise can be used to benefit self-regulation (Berti & Cigala, 2022). However, it is discussed in an extensive recent review of mindfulness work that the role of self-awareness on children’s self-regulation of emotions, attention, and behaviors, needs further study (Bockman & Yu, 2022). Specifically, there seems indeed to be a connection between the facets of mindfulness, self-awareness, and self-regulatory practices in children, yet how these all intersect needs to be addressed. In this way, this study seeks to explore the connection between the executive function skill of attention and a mindfulness intervention to promote it.

Benefits & Outcomes of Mindfulness Interventions

There is support in the literature that mindfulness interventions can aid self-regulation in young children, especially for behavior and emotion regulation, and can lead to positive academic outcomes (Bockman & Yu, 2022). Mindfulness programs have shown success through positive and significant impacts on students self-regulatory skills from pre-school to secondary education. Additionally, mindfulness programs have been studied in terms of internalizing and externalizing distress, psychological well-being, physical health, prosocial relationships, school behavior, and academic achievement (Roeser et al., 2022).

A meta-analysis by Zoogman et al. (2015) identified specific outcomes for populations that benefitted most from such techniques. This analysis revealed there were no significant effect size differences in terms of instructor experience, which was classified as instructor training to implement mindfulness interventions into curriculum versus having experience on implementing mindfulness interventions. Likewise, that was compared to intervention type, classified as mindfulness based on its benefits to stress reduction versus cognitive therapy and other forms of stress reduction. Zoogman et al. (2015) also compared a number of other factors such as if outside practice with interventions had been recommended to participants in the studies reviewed. Overall, it was found that psychological symptoms (i.e., anxiety, depression, aggression, and substance use), specifically in clinical samples (i.e., youth with mental illness), had stronger benefits for directly increasing attention over any other measure compared in the review. It was therefore suggested that the youth may be quicker to learn and benefit from such mindfulness meditation interventions than adults (Zoogman et al., 2015).

Some outcomes of mindfulness interventions have been studied more than others, such as externalizing distress and self-regulation. One area that could benefit from further research is

academic outcomes as so far there has been some evidence of mindfulness programs being successful with younger children on school behavior and performance (Roeser et al., 2022). Further, teacher mindfulness is likewise important. Those teachers who better observe their own self-regulatory practices in the classroom environment, are able to pay more attention to those children who may exhibit more challenging behaviors. Jeon (2022) demonstrated this through findings in a cross-sectional design that showed teachers who practice nonreactivity themselves in their classrooms will build positive outcomes for students as well. With this in mind, teachers play an important role in implementing mindfulness into a classroom.

Different types of intervention programs have been tested in preschools. There are long-term programs that focus on group-based intervention and run from beginning until the end of the school year intertwined with the curriculum (Raver et al., 2011). There are also short-term interventions that focus on individual-based intervention that last anywhere from one week to one month in duration. These can include two to five sessions per week over that span of time. Finally, there are also individual and group intervention trainings that include activities or games (Traverso, 2015). For example, two types of mindfulness interventions have been done with meditation and yoga, a practice that involves self-awareness and attentional practices through structured body movements. This has shown success in some respects but there is no conclusive evidence for it universally (Greenberg & Harris, 2011).

Razza et al. (2015) also presented a study that utilized yoga, where students engaged in the activity after circle time and before and after lunch (all of which are times of transition for the children). In this work, attention, executive control, and executive function were successfully promoted by the implementation of the yoga task. This task consisted of children performing a sun salutation, a popular set of yoga poses which is an exercise done to help facilitate breathing

typically before working out on other movements. A systematic review of studies done using mindfulness and/or yoga as an intervention suggests that programs appear to have better outcomes for social-emotional developmental improvement (classified as a wide range of skills such as self-awareness and decision making) if the intervention is implemented for at least 6-weeks in early school programs. Some of the studies in this review used randomized control trials, some quasi-experimental designs, and others pre-post designs. Some of the studies used supplementary instruction on gratitude, kindness, and empathy in order to evoke self-reflection in addition to the breathing techniques and yoga postures from the intervention. The concluding note by the authors is that more understanding about why interventions are effective than how they are conducted is needed (Sun et al., 2021). This can possibly be explained by the benefits that mindfulness practices bring to self-awareness and attention (executive function abilities).

It is of importance to note that many studies have found success in finding differences between their control and intervention groups post activity (i.e., Razza et al., 2015; Zelazo et al., 2018). Zelazo et al. (2018) for example, used multiple measures such as a version of the Head Shoulders Knees and Toes Task, teacher reports, literacy measures, and some other additional tasks to test small-group intervention sessions pre- and post with children. By contrast, Razza et al. (2015), mentioned earlier, used a curriculum called Yoga Kids that was adapted for preschoolers in New York city classrooms. There was a control classroom and intervention classroom, in which case the teacher kept a log of activities with time recordings. This intervention log showed around 40 hours of mindful yoga across 25 weeks, with gradual increases. In addition, a number of breathing exercises were performed at various points of the day (morning, afternoon, and transitions). A number of executive functioning tasks were measured, including the Head Shoulders Knees and Toes Task (HSKT), similar to Zelazo et al.

(2018). For Razza et al. (2015) improvements were seen in tasks especially for the intervention group's ability to inhibit behavior and attention. Jackman et al. (2019), likewise did an intervention with 3- to 5-year-old children at a Head Start program by training teachers at one of the preschools to implement a program called OpenMind into the daily curriculum. This program entails inclusion of yoga, gratitude practice, kindness, and compassion practice, and much more. In this case, the comparison group performed a Trust-Based Relational Intervention that works on teacher-child bonding activities. Teachers in the test condition reported improved self-regulatory skills in their students through emotional awareness and self-calming techniques.

Berti and Cigala (2022) is a more recent example where a HSKT task was used as well as a Go/No-go Task and mindfulness intervention showed significant improvement in preschoolers ability to self-regulate. For the Go/No-go task the children in this Italian preschool were shown random digital stimuli that had to correspond correctly with a go or a no-go response, meaning they had to either react (go, to stimuli that came on the screen) or inhibit (no-go, to an alternative stimuli that came on the screen). The goal of this task is to measure attentional focus as well as impulsivity and inhibitory control. For the HSKT task children play a form of Simon Says where one person asks the other to do an action like "touch your nose". This task required participants to pay attention to what they are instructed to do, but to actually perform the inverse action (e.g., when told to touch their head the correct response is actually to touch one's toes). This required inhibiting the impulse to react to the stated action and pay attention to what they are doing by performing the opposite way. For both tasks children showed improvements in the experimental groups from pre to post testing. With this all in mind, and other related work in the field of mindfulness and the benefit to educational practices is ever-growing and expanding its preexisting knowledge base. Therefore, this current work intends to use a week-long mindfulness

intervention in a preschool classroom to test for the potential benefits to executive function abilities as it aids skills like attention and self-regulatory behaviors.

Current Study

If the executive function skill of self-awareness is a key part to self-regulation and mindfulness, and mindfulness can lead to improvement in those abilities, then how might preschool children benefit from early practice of mindfulness? Could both self-regulation and attention be fostered? Given extensive research into these respective areas, this current work sought to explore further the bridge between the well-defined concepts of executive function and self-regulation in preschool age children and its relation to mindfulness interventions in classrooms. Specifically, this work predicted that through a brief 5-day classroom group intervention aimed at focusing attention, students would show improved scores on classic executive function tasks when comparing pre- and post- intervention scores.

CHAPTER 3

METHOD

Recruitment

Permission was gained through the school system following Georgia Southern University Institutional Review Board (IRB) protocol for working with minors (IRB protocol number 23237). In total, permission was obtained by the child, the child's guardian, the local school administrative point person, and the IRB. All children in the participating classrooms were given a small gift bag containing a fidget toy, a row of stickers, two pieces of chocolate, and package of fruit-snack gummies at the end of the last day of participation. There was no cost to the participant; the children or guardian were free to end participation at any time (during the 5-day intervention) as it was fully voluntary.

Administrators at four local private childcare centers located in Statesboro, Georgia, USA were contacted via e-mail and phone by the research investigator. These schools included: Kids World Learning Center, Georgia Southern University Child Development Center, Super Kids Child Care Center, and Bumblebees Childcare Learning Center. Consent forms were distributed to parents of potential participants by the preschool administrators at pickup times two weeks prior to the study. This complete document consisted of a variety of key information and was followed by a brief optional demographic survey along with reminder flyers for research dates (see Appendix A and Appendix D). Any questions were answerable through the email provided on the flyer, yet no guardians reached out. Children who were not participating continued to be engaged in alternative activities with their classroom instructor as regularly done during the day. Once a given child's legal guardian provided consent, the child additionally was asked to

volunteer to participate by providing verbal assent at each day of participation or could choose to remain with the rest of their peers during regular classroom activities.

Participants

Each local school had one classroom that participated at random (using a coin toss) in either an intervention group or a control group. The target sample were preschool age children within these classrooms that provided parental and child consent. The original sample was N = 42 recruited from the four local schools before eliminations ($N_{Control}$ = 14 , $N_{Intrvention}$ = 28). As planned prior to data collection, some children were excluded from the dataset due to absence during the pre- or post-test assessment or multiple days during the administration of the intervention or control. Children who were absent and/or who chose not to participate more than 3 days, were excluded, yet all children participated more than 3 days that the intervention was administered, for an average of 4 days of participation. Children who did not complete both dependent measure tasks before (N = 3), and after (N = 2) the intervention were removed from the final dataset. Children were also eliminated for being absent for both the pre and post testing days (N = 2) and missing data due to quitting early (N = 3). This resulted in the final obtained sample (N = 32) with an intervention group (N = 26), comprised of Kids World Learning Center (N = 16) and Bumblebees Childcare Learning Center (N = 10), and the final control group (N = 6), comprised of Super Kids Child Care Center (N = 3) and the Child Development Center at Georgia Southern University (N = 3). This study included children ages 3- to 6- years (M = 4.69, SD = .11) with age in months ranging from 30 months of age to 86 months of age (M = 60.2, SD = 1.64). Of that final sample the demographic breakdown for race/ethnicity was: 46.9% White (N = 15), 25% African American (N = 8), 9.4% two or more (N = 3), and 3.1% preferred not to say (N = 1). The household family makeup included: 18.8% two-parent household with no siblings

(*N* = 6), 40.6% two-parent household with siblings (*N* = 13), 3.1% one parent household with no siblings (*N* = 1), and 18.8% one-parent household with siblings (*N* = 6). Additional demographic factors were collected regarding the sample and can be found in Table 1. The total sample needed via a power analysis on G*Power software (Faul et al., 2007; a power of .8, effect size (Cohen's F) of .25, with 2 groups, 2 measures, and alpha of .05), was *N*=34 per group. As such, comparing the target sample with that which was obtained, this study was underpowered (see Discussion for additional information regarding this limitation).

Materials & Measures

Printed consent forms, demographic surveys, and flyers (see Appendix D) were used for participant recruitment. The demographics survey included questions on age, ethnicity, household annual income, and highest level of caretaker education. Data collection occurred in classroom spaces designated by the school administrators and teachers. For all schools this was inside the existing classroom the students were in, at an empty table, except Super Kids Child Care Center which was in the teachers' lounge per headmaster request. For the intervention activity a wide open space where circle time is held was used (i.e., a rug area). One PC laptop from the researchers laboratory was used to collect data for pre- and post-intervention executive function tasks. This was locked and kept under the care of the researchers at all times. Two research assistants were also supervised and trained by the graduate researcher to administer the data collection through two tasks: an observationally coded self-regulation-based task and a computer-administered attention-based task.

Executive Function Tasks

The first task was an adapted Fish-Shark Go/No-go Task administered with E-Prime (Psychology Software Tools Inc., Pittsburgh, PA, USA). It is a well cited measure of response

inhibition and followed similar design structure as used in, Wiebe et al. (2012). This task is used to measure attention, an executive function skill using the recordings of response time, and response inhibition for no-go trials Previous studies conducted with this task used 40-trials, which is beneficial for this study as well given the short attention span of young children. Using the procedure developed by Wiebe et al. (2012), each trial terminated when a child provided a response (i.e., either a correct "go" response or an incorrect response on a "no-go" trial) or after 1,500 ms. The reaction was recorded via the push of the spacebar on the PC laptop.

The Go/No-go Task is typically completed as a game. Children began by sitting in front of the PC laptop where they were presented with the task, as labeled: Fishing Game. The researcher began by entering a participant number and session number information for the child and then proceed through two demonstrations trials, one for each of the two stimuli, a go-response (presentation of a fish), and a no-go-response (presentation of a shark). A brief pause allowed for any questions before the child was then given 3 practice trials, one go trial, one no-go trial, and one go trial. Another brief pause followed at which point the child was asked if they were ready to begin the game. On a typical trial, an underwater scene appeared with one of the two stimuli presented to children at random, a small cartoon fish or a small cartoon shark (See Appendix C). Stimuli appeared center screen until the child pressed the spacebar, reacting to catch the fish, or until the duration of the trial ended. Participants could then make one of two choices when responding via the computer keys; specifically, they can choose to respond or inhibit responding (i.e., it is a forced choice task). The child would need to respond to go-stimuli by pressing the spacebar to catch fish or inhibit from responding to no-go-stimuli by failing to press the spacebar as to avoid catching sharks. Participants were given feedback on each trial, either a green checkmark to indicate a correct keypress response on go (i.e., fish) trials or a

correct non-response on no-go (i.e., shark) trials or a red-X to indicate an incorrect non-response on go trials or an incorrect keypress response on no-go trials.

In this study, the go stimulus was presented more frequently (N = 30) as is typically done, such that a tendency to respond is prompted and inhibition could be measured on the no-go stimulus presentation (N = 10). Again, this requires the child to pay attention to his or her behavior. A successful non-response was considered inhibition measured by not pressing the computer key (i.e., spacebar). Each individual participant's responses were measured for every trial, creating pre- and post- response time and proportion correct accuracy measures.

The second task was a Head-Shoulders-Knees-Toes task – HSKT. Ponitz et al. (2008) developing this task and found validity and reliability for this easy to deliver observational task with longitudinal benefits. Previously used by Razza et al. (2015), this well-cited task measures behavioral self-regulation, another executive function skill, through observation. Like the first task, inhibition and attention is needed, both skills that the mindfulness intervention promotes. This validated measure of self-regulation is often used with children 4 to 8 years of age. Children have to inhibit the automatic response to imitate the examiner by doing the opposite action asked of and presented to them (Sun et al., 2021). By having the experimenter display the action, enact the action, and expect the opposite, the child must inhibit the desire to mimic and pay attention to their own bodily movements. The benefit to this is that unlike the Go/No-go task, the HSKT uses large motor coordination which reflects how children control behavior in everyday classroom environments (Ponitz et al., 2008).

Children were given an example of each movement as a visual model for how the game worked, and then were given 5 practice trials, before being tested on 10 trials, similar to Razza et al. (2015). In this task, children had to perform the opposite action of a behavioral command

given by the researcher (See Appendix B for a more detailed script). For example, if told "touch your toes" by the researcher, the participant would perform the opposite and touch their head. If told to "touch your shoulder" the participant would perform the opposite and touch their knees. This was scored as accuracy on paper as 0 (*incorrect*), 1 (*self-corrected*), and 2 (*correct*) for a total of 0 to 20 points for the 10 trials per child. The higher the score, the better the self-regulation in that child; a score above 15 points is considered high.

Each participant completed both the Go/No-Go task and the HSKT task. The primary researcher conducted the HSKT task with all participants (including coding their responses). When available, one of two research assistants conducted the computerized Go/No-go task with one participant while the primary researcher conducted the HSKT task with another participant, and, upon completing each task, participants alternated to the other task. When the research assistants were not available due to scheduling difficulty, the primary researcher conducted each task sequentially with an individual participant.

Intervention & Control Activity

The intervention and non-intervention tasks were both intended to be incorporated in the daily routine of the instruction so that the children repeated the task each of the 5 intervention days. For the intervention group, the task consisted of the experimental mindfulness activity that involved 10 minutes of daily work each day using a 5 minute sun salutation, a form of yoga exercises commonly performed to focus breathing and previously used in studies such as Razza et al. (2015). They employed both a yoga and a 5 minute breathing exercise, and both were adapted for this study. The 5 minute breathing exercise is known as Take 5 (Razza et al., 2015), and can be used anytime the child feels they need to regulate themselves emotionally or

behaviorally through this technique. Both tasks were run through with research personnel and children as a group.

The sun salutation is a warm-up yoga movement that is done to begin focusing breath. The meaning behind it is to thank the sun and greet it through a formation of postures. The sun salutation was taught using a video based on a book by Sarah Jane Hinder (Sounds True, 2019) and modeling behavior. The goal of the sun salutation is to center one's focus on breath using body movements. This is directly aimed at focusing attention and self-awareness, two key executive function qualities. For the Take 5 task, children were asked to place one hand out in front of them with their fingers placed slightly apart. Children traced their fingers using the other hands pointer finger and inhaling as they went up their fingers, and exhaling as they went down their fingers. This was done for a total of 5 breaths, one for each finger (McClaney, 2020). The goal of the Take 5 task is to provide children a technique for physiologically regulating their body through breath to help regulate emotions and behaviors. This is likewise directly aiming at focusing attention and self-awareness to promote self-regulation.

For the control group, the task consisted of a video reading and reflection activity that likewise involved 10 minutes of daily involvement in a group setting. This task was unrelated to the improving of executive function assessment tasks. Specifically this alternative control activity included watching a read video book for 5 minutes on gratitude for children (Liu, 2022). This task was followed by 5 minutes of a reflective question about the book day one, "What are you grateful for?". The second to fourth day children got 20 minutes (this includes set up for craft) to work on a craft activity instead of the book activity. This included creating their own gratitude jars as described in the book. Day 1 was decorating the gratitude jar, Day 2 was finalized decorating, and Day 3 was creating gratitude items by drawing on paper and placing it

into the jar. The final day, the video book was read again and concluded with 5 minutes of final reflective questions: “What is your favorite gratitude item you included in your jar?” See Appendix B for sample instructions for the intervention and control groups. On the final day, once all data was collected, children received their small token of appreciation and were given a brief verbally administered age appropriate debrief on the study while being sent home with a more detailed debrief flyer for caregivers (see Appendix A).

Procedures

Children who were granted guardian consent to participate were asked to verbally assent each day before engagement with the task and/or the activity. Both an on-site staff member or classroom teacher, an individual the child feels safe and familiar with, were present at all times during the study. Additionally, one of the two undergraduate research assistants was present for the duration of the study on most days. This study took approximately 60 to 90 minutes to complete on Day 1 and Day 5, and 10 to 20 minutes on Days 2, 3, and 4 total, for all participants recruited at each site (see Figure 1 for participant flow).

On Day 1 of the study the children were asked to provide verbal assent before individually being tested on two executive function tasks with one of two research assistants or the graduate researcher. This was done in a separate part of the classroom, separate from the other uninvolved students, as to minimize disruption to the daily curriculum of the school. When a research assistant was present, two children could be working at the same time to complete the tasks separately, as there was a PC laptop for the one task, while the other involved tracking written points. Each of the two executive function tasks took approximately between 5 to 10 minutes to complete for a total of up to 20 minutes per participant. The child could take a break between the tasks as needed or decide to end participation. Children participated in regular daily

activities while their peers completed the tasks. Once each child finished both of the pre-intervention or pre-control measures, then the full group of participating children could begin Day 1 of the intervention or control activity. Per school classroom random assignment, all children would either perform the 10-minute mindfulness intervention (5-minute additional instruction time needed Day 1), or the 10-minute no intervention control group gratitude activity (which likewise had an additional 5-minite instruction period). Once completed, the first day of data collection was over. Children who were not participating remained in their regular classroom activities without disruption during that full period.

On Day 2, Day 3, and Day 4, children in both groups likewise participated in the intervention mindfulness task or control gratitude activity for the 10 to 20 minute duration as done on Day 1. The researcher came in, took attendance, ran the activity, and departed. No other data other than attendance was collected each of these days. There were two check points (Day 2 and Day 4) where children were asked about their participation in the daily intervention or no intervention groups to ensure that they are engaging with the mindfulness or control activity. This included asking them prior to the start what the task is called (i.e., Sun Salutation; gratitude jar) and what they need to focus on (i.e., breathing; things they are grateful for).

On the final Day 5, the same procedure as Day 1 followed with the reverse order. First, the intervention, then the post-intervention executive function tasks independently measured for each child, and finally a brief individual debrief and presentation of a compensation take-home bag. This took approximately 2-minutes for the small token of appreciation to be provided to each child as well as an age-appropriate explanation of the study. Children could likewise ask any questions they may have had at that point. Teachers were provided a flyer to send home to

each caretaker to thank them for their willingness to participate with a more detailed adult debrief about what the data was used for (See Appendix A).

CHAPTER 4

RESULTS

It was expected that a brief 5-day 10-minute mindfulness intervention with preschoolers would yield significant results on a Go/No-go Task and HSKT Task. This study utilized a 2 x 2 Mixed Model ANOVA design to test pre- versus post-test and intervention versus control group effects. The test-phase (pre versus post) was examined as a repeated measure and the test-group (intervention verse control) was examined as an independent groups factor. See Table 2 for means and variability estimates. For the HSKT Task, accuracy was measured based on the 0 to 20 point system described earlier and utilized in Razza et al. (2015). For the Go/No-go Task, both accuracy and reaction time were measured. As utilized by Wiebe et al. (2012), *d′* was calculated for each participant as the difference between their standardized *z*-score hit rate on go trials and their standardized false alarm rate on no-go trials and was used as the primary dependent measure on this task. As a note, trials on the Go/No-go task with reaction times faster than 200ms were eliminated from analyses, because they indicate responses that were made too quickly for the participant to have processed the stimulus.

To test the predictions, a 2 x 2 Mixed Model ANOVA design was utilized via SPSS analysis. For the Go/No-go Task accuracy measure, contrary to what was predicted, the main effect of test-phase was statistically not statistically significant, $F(1, 30) = .154$, $p = .70$, $\eta 2 = .01$, due to minimal difference in accuracy in the pre-test condition (Hit Rate, $M = .802$, $SD = .19$, False Alarm Rate, $M = .15$, $SD = .20$), to that of the post-test condition (Hit Rate, $M = .860$, $SD = .133$, False Alarm Rate, $M = .194$, $SD = .242$; note, although *d′* values were used in the analysis, descriptive statistics for hit and false alarm rates are provided here for maximal clarity in reporting the repeated-measure values). The main effect of test-group was also not statistically

significant, $F(1, 30) = .90$, $p = .56$, $\eta 2 = .012$, again due to similar accuracy rates in the intervention condition ($M = .11$, $SD = 1.32$), and the control condition ($M = -.46$, $SD = 1.40$). Our prediction that the intervention group would outperform the control group specifically in the post-test phase was not supported, as the test-group by test-phase interaction was not statistically significant, $F(1, 30) = .394$, $p = .54$, $\eta 2 = .013$. This means the intervention group pre-test scores ($M = .13$, $SE = .29$, $CI = [-.46, .72]$) did not significantly differ to the intervention scores post-test ($M = .08$, $SE = .27$, $CI = [-.47, .63]$), and the control group pre-test scores ($M = -.58$, $SE = .60$, $CI = [-1.9, .65]$) did not significantly differ to the control scores post-test ($M = -.35$, $SE = .56$, $CI = [-1.5, .79]$). There was no significant difference in accuracy between factors for the Go/No-go Task (See Figure 2).

Another 2x2 Mixed Model ANOVA explored the Go/No-go reaction time measure. A main effect of test-phase was statistically significant, $F(1, 30) = 7.386$, $p = .011$, $\eta 2 = .198$, due to faster response times at post-test ($M = 780.89$, $SD = 200.18$) than at pre-test ($M = 879.39$, $SD = 192.74$). For test-group, there was also a statistically significant main effect, $F(1, 30) = 4.677$, $p = .039$, $\eta 2 = .135$, due to faster response times in the intervention condition ($M = 797.94$, $SD = 178.63$), than the control condition ($M = 969.67$, $SD = 157.76$). Yet, the analysis revealed that the test-phase by test-group interaction was not statistically significant, $F(1, 30) = 1.010$, $p = .323$, $\eta 2 = .033$ (see Table 2 for test-phase by test-group descriptive statistics). Therefore, these findings suggest that children were quicker to respond during post-test than pre-test and those in the intervention condition were faster to respond than those in the control condition, but there is little evidence to support the prediction that those in the intervention condition benefited differentially from the mindfulness activities (See Figure 3).

For the HSKT task, a main effect of test-phase was statistically significant, $F(1, 29) = 6.690$, $p = .015$, $\eta 2 = .187$, due to lower accuracy in the pre-test phase ($M = 10.29$, $SD = 6.04$), than the post-test phase ($M = 13.28$, $SD = 5.51$). There was no statistically significant main effect of test-group, $F(1, 29) = .1723$, $p = .200$, $\eta 2 = .056$, due to similar accuracy in the intervention condition ($M = 12.23$, $SD = 4.84$), and the control condition ($M = 9.50$, $SD = 5.96$). Our prediction that the intervention group would outperform the control group specifically in the post-test phase was not supported because the test-group by test-phase interaction was not statistically significant, $F(1, 29) = .003$, $p = .958$, $\eta 2 = .00$. These findings suggest that participants improved on this task between the pre- and post-test phases, but this improvement applied similarly to those in both conditions (See Figure 4).

CHAPTER 5

DISCUSSION

Review of Purpose

Executive functioning is significantly related to the learning ability children have (Bull et al., 2008), and the longitudinal contribution it brings to literacy and mathematic ability as these children enter school (Blair & Razza, 2007). Benefits to training younger children's executive function skills can begin in preschool in anticipation of school readiness as to yield benefits to educational growth (Melby-Lervag and Hulme, 2013). The advancement of executive function research in the past decades has provided insights into the links between executive function and general intelligence, primarily with young children and more so for the potential to target the individual developmental differences these children may exhibit early on (Blair et al., 2005). Self-regulation, one key facet of executive functioning, is of particular interest in preschool development. It is defined as one's ability to understand and subsequently also manage one's emotional and behavioral responses to the world.

Mindfulness-based interventions have been shown to improve self-regulation, a key executive function skill. The idea behind mindfulness is building up sustained attention through the use of attentive breathing and intentional body movements. Being aware of the sensations one feels and the thoughts one has during this exercise, brings about a calming effect in the body and mind (Schöne et al., 2018; Malinowski, 2013). With children in schools, high arousal can negatively impact their ability to self-regulate, emotions and behavior, causing disruption to classroom engagement and performance. This is why early intervention, like mindfulness techniques implemented into classroom curriculum, can teach children to lower arousal and self-

regulate at higher abilities. In many ways, mindfulness is the practice of self-awareness, which is a skill young children are largely developing in preschool (Eisenberg et al., 2010).

It was expected that the executive function skill of self-awareness, a key part to self-regulation and mindfulness, could lead to improvement in preschool children's abilities on executive function tasks as practice of mindfulness is linked to self-awareness. Given extensive research into executive function and mindfulness, this current work seeked to explore further the relationship it has with preschool age children through utilization of interventions in classrooms. The goal of this work was to broaden the existing literature at the intersection between preschool age self-regulation and executive function research, as it pertains to mindfulness interventions in an educational setting. This study seeked to test if executive functioning could be improved from pre to post mindfulness activity (compared to a control) as measured by two well cited executive function tasks.

Review of Findings

This study expected to find that the brief 5-day classroom group intervention aimed at focusing attention, would yield improved student scores on HSKT and Go/No-go executive function tasks when comparing pre- and post- intervention scores, by condition. As reviewed in the results, a 2x2 Mixed Model ANOVA design was utilized to test this studies predictions. It was predicted that there would be a main effect of test-phase, as represented by higher accuracy and faster reaction times post- over pre-intervention exposure. This prediction was found to be significant for the HSKT accuracy measure, yet not for the Go/No-go accuracy (*d*') measure. In terms of reaction time on the Go/No-go measure, there was likewise significance in the test-phase.

It was also predicted that there would be a main effect of test-group, which the reaction time on the Go/No-go measure also yielded. For the test-group main effect in the HSKT accuracy measure, there was no significance, and neither for the Go/No-go accuracy (*d*') measure. Finally, this work expected to find a test-phase by test-group interaction for each measure such that there would be similar pre-test performance by group, and greater improvement in post-test performance in the intervention than control condition. None of the three reported interaction effects, however, were statistically significant, failing to support they study's main prediction.

This work is largely promising for the field of research with preschool executive functioning and mindfulness practice through intervention, yet this work leaves much space for improvement. Although the present study found limited significance, it might be worth further benefit to investigate the Go/No-go task with preschoolers as it does show promise as a measure in this area of research. Per predecessor study, Wiebe et al. (2012), which was utilized here for similar Go/No-go structure, found improvements in working memory and cognitive ability, especially with children of 3 years of age. In terms of the HSKT task, it was of much higher difficulty to younger ages as may be seen with previous age ranges using this measure (typically 6- to 8-years of age; Sun et al., 2021). For example, the similar procedure followed here as used by Razza et al. (2015), found significance in an Italian preschool classroom. The implications of this study are largely the confirmation that mindfulness interventions can be implemented into preschool classrooms, and effects are observable with pre- to post-test executive functioning improving on some measures.

In a recent review of current research in executive functioning and preschoolers, it was states that many questions remain unanswered despite the past 15 years of research in this area

(Mattera et al., 2021). These are key gaps in the theory that still need to be explored to better understand how preschool executive functioning development can be targeted. One of these questions pertains to the timing of interventions. As discussed in this work, preschool is traditionally targeted, yet Mattera et al. (2021)suggests that there is inconsistency in effects of such skills across findings in preschools and elementary schools. Therefore as in this present study, using a variety of schools to compare executive functioning skills of preschools, is more beneficial to balancing the curriculum differences in executive function development exposure.

Continuing with the area of expansion within this current work, more recent research via a systemic review by Muir et al. (2023) suggested that the self-regulation and executive abilities in preschoolers could potentially be intentionally enhanced by the social, emotional, and behavioral contexts of these children in their early educational experiences. The key finding of the review is that the following, ‘what the intervention is’, ‘who the intervention is done by’, ‘whom it is done with’, ‘when it is done with’ and ‘how it is carried out’, all influence the approach and potential outcome that interventions have with preschoolers. This study yields yet another approach to all of these questions. There are however unanswered challenges to the implementation of interventions into school curriculums. So far, those interventions that have been successfully integrated show potential for continued structure and advancement. There is potential therefore for this intervention and others like it to be equally as promising. That said, Muir et al. (2023) also suggest the need for longitudinal research into the outcomes of interventions on self-regulation and executive functioning as it relates to sustainability of the various intervention procedures. Meaning for this current work, it is only one example of a program, and must be considered against others longitudinally.

Next, one suggestion for expansion that this project does not consider, is the importance and influence of parental figures in the development of executive functioning. A study by Regueiro et al. (2021) found that paternal engagement in mind-mindedness (i.e., parental verbal behavior signifying consideration for the child as autonomous being with a separate mental state to their own) during toddlerhood, improved executive functioning in early school. Something that had previously also been found with maternal engagement, is now being looked at with paternal engagement, given the lack of research in that area. The work by Regueiro et al. (2021) should be considered moving forward with the study of mindfulness interventions and preschoolers. There is room for this current research to expand not only into school settings, yet into the influences of key individuals in these preschoolers executive development.

Limitations

One major limitation in this study is the lack of power in the sample size due to accessibility and time constraints with this project. Part of this issue too was that participants were children which meant the consent to conduct this work had to be received from both the parent and assent from the child. Therefore, participation was hard to recruit and maintain as children were absent or unwilling to partake at various points during the study. This too includes the imbalance in group sizes as the control group had fewer participants than the intervention, even with the random assignment. As this was not foreshadowed given that each class had similar student numbers, it must be an issue that arose from the recruitment of parents at each school, especially the control schools. If more time had been available for this project, a larger amount of schools or classrooms to recruit from may have aided in this issue.

Likewise, the fact that there was no data collected regarding the prior knowledge base of each child and school when it comes to mindfulness practice, could be a limitation. For example,

there might be an effect on performance if children had prior experience with yoga or gratitude jars, it could have impacted their results in the intervention and control groups. Aside from exposure to similar activities, there may have been a potential practice effect on participant performance from pre- to post-test. Given the exposure to the task Monday for the first time, children may have been more challenged that day, than the exposure to the task Friday for the second time. However, typically the inclusion of a control group design alleviates these practice effects from pre- to post- measures. Given all these limitations, if addressed, the current results might have yielded higher effect sizes or been more generalizable.

General Conclusions

As discussed in the above sections, although this current work provided limited significance, the findings yield further knowledge buildup for the expanding literature on mindfulness and executive functioning during early childhood. Much of what current research suggests is that there is benefit to implementation of mindfulness practice into the early childhood curriculum. Therefore, future work conducting research on mindfulness and its benefits to executive functioning in preschoolers in classroom settings may benefit from taking a longitudinal approach to interventions and academic outcomes.

Additionally, there might be an advantage to improving recruitment strategies from those in this work, especially given how parents are contacted for a study as this one with young children. Studies could likewise compare varied educational settings where the teaching philosophy may lend itself differently to the incorporation of mindfulness, such as schools following the Maria Montessori curriculum, as compared to a traditional statewide curriculum. Likewise, utilizing a different intervention strategy in place of yoga and gratitude could be considered. There is potential for a different mindfulness activity to yield significant results with

this current age group or an older group of elementary-school age children, as has been investigated in Tarrasch (2018). Utilizing a mindfulness based 10-week workshop, this study measured third-, fourth-, and fifth-grade students attention capabilities with a visual search task. The results suggest that a workshop in mindfulness, that made use of weekly exercises (i.e., breathing awareness, mindful eating, and walking meditation), can be effective at improving attention, measured with an executive function task, in elementary-school age children. Perhaps some of these mindfulness exercises would be similarly effective with younger children, as were studied here. Finally, research into mindfulness with developmentally delayed children or potentially children who show signs of early learning disabilities, might likewise be of interest given the benefits cited in the literature (Coelho et al., 2018; Woodward et al., 2016). In conclusion, this line of work shows promising benefits to early intervention of preschool age children's executive function abilities as they begin their schooling journey.

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TABLES

Table 1.

Descriptive Statistics with Sample Size and Frequency.

	N	Percent
Total Sample	32	--
Intervention	26	81.2
Control	6	18.8
Gender		
Female	17	53.1
Male	15	46.9
Race/Ethnicity		
White	15	46.9
African American	8	25.0
Two or ore	3	9.4
Prefer not to say	1	3.1
Family Household Makeup		
Two-parent with no siblings	6	18.8
Two-parent with no siblings	13	40.6
One-parent with no siblings	1	3.1
One-parent with siblings	6	18.8
Other (Two-parent sibling to be)	1	3.1
Caretaker Education		
Some High School	1	3.1
High School	5	15.6
Some College	7	21.9
Bachelor's Degree	5	15.6
Master's Degree	6	18.8
Ph.D. or higher	2	6.3
Other (associate degree)	1	3.1
Family Household Income		
Less than $25,000.00	1	3.1
$25,000.01 to $50,000.00	9	28.1
$50,000.01 to 100,000.00	5	15.6
$100,000.01 to 200,000.00	7	21.9
More than $200,000.01	1	3.1
Prefer not to say	3	9.4

Note. Missing data because parent chose not to or otherwise failed to provide answers ($N = 6$)

Table 2.

Estimated Marginal Means.

					CI (95%)			
	M		*SE*		*Lower Bound*		*Upper Bound*	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Go/No-Go *d'*								
Intervention	.13	.08	.29	.27	-.46	-.47	.72	.63
Control	-.58	-.35	.60	.56	-1.9	-1.5	.65	.79
Go/No-go Reaction Time								
Intervention	852.74	743.14	36.74	36.60	777.70	668.40	927.78	817.89
Control	994.88	994.46	76.49	76.18	838.67	188.87	1151.09	1100.05
HSKT Accuracy								
Intervention	10.88	14.08	1.203	1.079	8.42	11.87	13.34	16.29
Control	7.83	11.17	2.46	2.20	2.81	6.66	12.86	15.67

FIGURES

Figure 1.

5-Day Intervention Participant Flow Chart (for two of four schools)

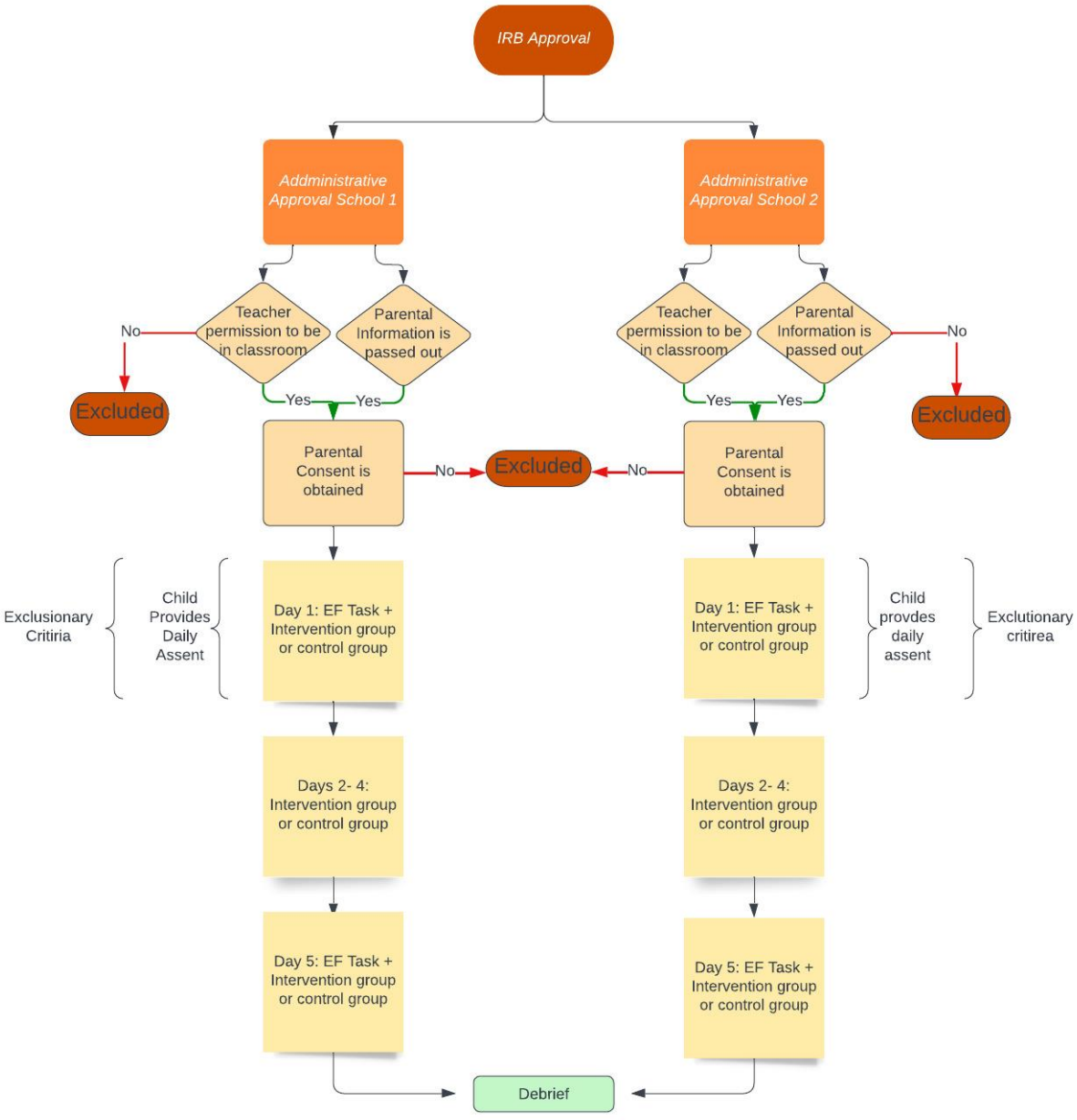
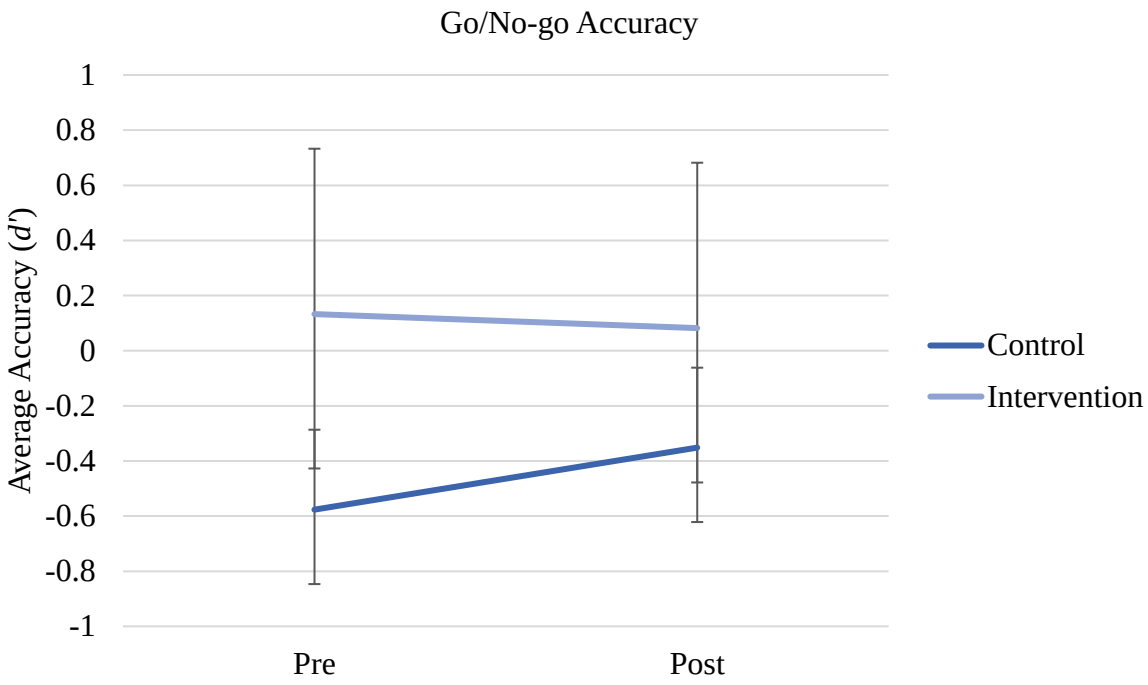


Figure 2.

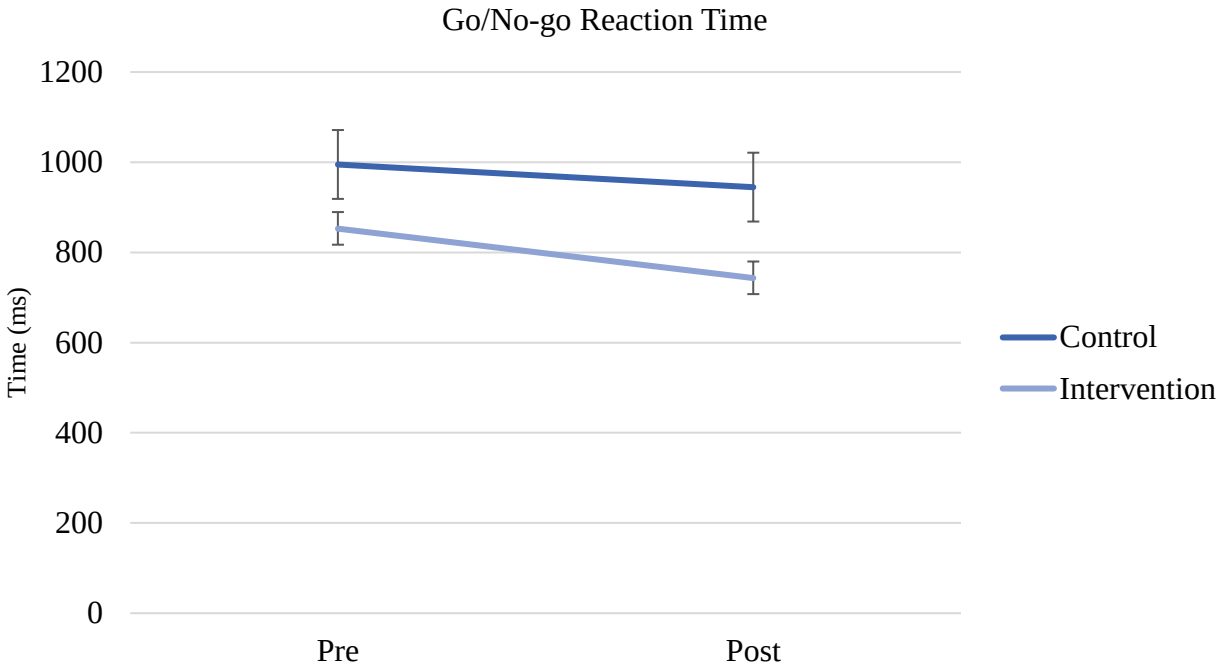
Go/No-go Accuracy Results



Note. For this task $N = 32$.

Figure 3.

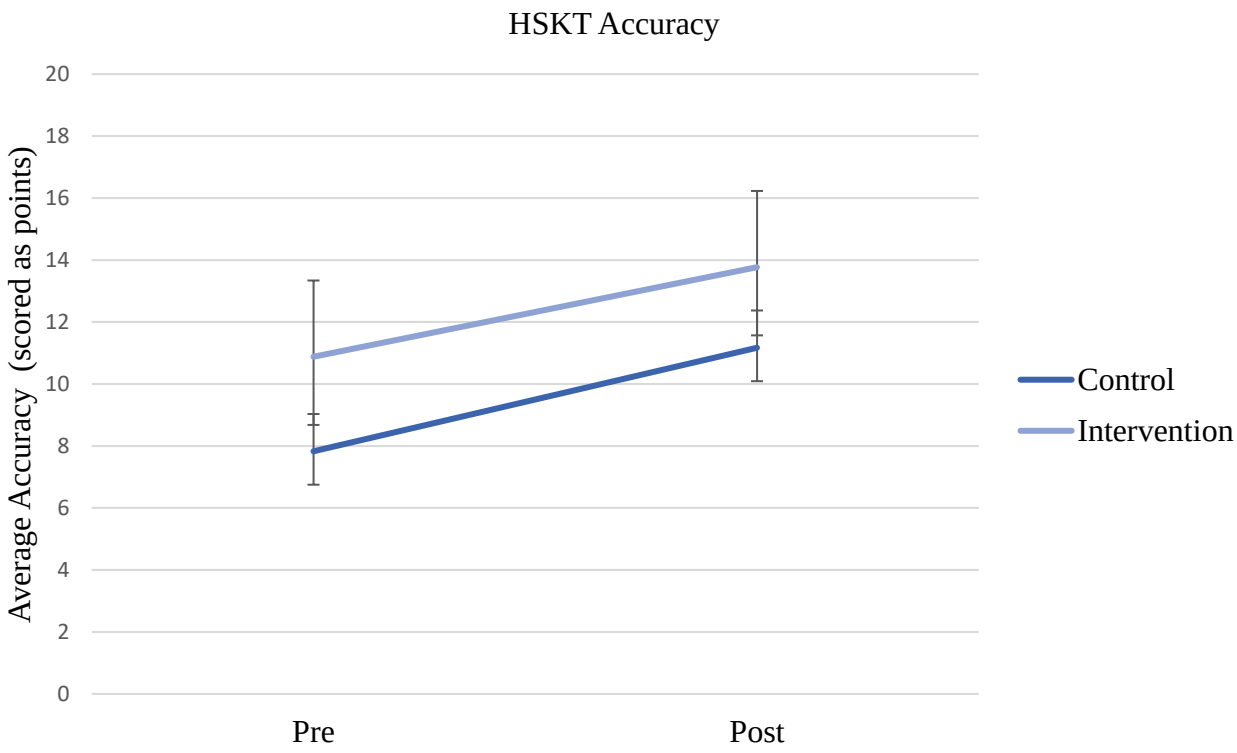
Go/No-go Reaction Time Results



Note. For this task $N = 32$. Anyone who reacted faster than 200 ms was eliminated.

Figure 4.

HSKT Accuracy Results



Note. For this task $N = 31$.

APPENDIX A

FLYERS

Note: Flyer sent upon signing consent

Note: Flyer sent upon completion of study.

THANK YOU FOR YOUR PARTICIPATION

THIS RESEARCH INTENDED TO STUDY THE EFFECTS OF BRIEF DAILY MINDFULNESS TASK ON CHILD EXECUTIVE FUNCTION AND SELF-REGULATION

- Executive functioning is considered an umbrella term for important cognitive skillsets such as attention and self-awareness.
- Children engaged in two tasks Monday and Friday to test for potential improved levels of skill.
- The mindfulness task included a brief 10 minute daily yoga and breathing task that can be implemented into daily curriculum.
- All children have been compensated for the task with a small token of appreciation.

Should you be interested to learn more about the topic or study as a whole, please email ll12276@georgiasouthern.edu

GEORGIA SOUTHRN UNIVERSITY

APPENDIX B

MINDFULNESS INTERVENTION & CONTROL ACTIVITY

Note: These were generally the instructions provided.

Script for Intervention

DAYS 1 & 5

SIT PARTICIPANTS IN GROUP ACTIVITY AREA PROVIDED BY SCHOOL

- Today we will be watching an audio book story together as a class. Once the video is completed, we will do an activity together. If at any point you do not want to participate you can let one of your teachers know and go back to your regular classroom activity.
- Remember, when we listen to a story, we need to have our listening ears on, so let me see all of you put your listening ears on and catch a bubble.
- Pause story if too loud and remind students to listen.

SHOW VIDEO: https://www.youtube.com/watch?v=5_tkAzN0Pw4

- Great work everyone!
- The story was showing us how to conduct a type of Yoga exercise. Raise your hand if you heard of yoga before. Well, today we will all get the chance to try Yoga!
- Everyone stand up!

HELP CHILDREN HAVE ENOUGH SPACE (~1 arm's length between them)

- We are going to perform the Sun Salutation together now! Are we ready?

PERFORM SUN SALUTATION AS GROUP

- Lead movements with own body and display video pictures on screen bye pausing for each movement.
- Great work Everyone!
- Now that we have finished this activity, we will do a second activity for which we all need to sit down for.

HAVE STUDENTS SIT DOWN AGAIN

- EXPLAIN TAKE 5:
    - This activity is called Take 5! Anytime you feel like you are upset, you can do this activity.
    - First place your hand on the floor, I will place mine in the air so you can see.
    - Now, we are going to take our other hand and trace our fingers...
    - We will take a big breath while we go up the mountain (move up your finger), and exhale while we go down the mountain (move down your finger).
    - Exaggerate breath to show when to breath.

    - Repeat for all 5 fingers
    - Let's do that again! Repeat so it is done three times.
    - Great work Everyone!

DEBRIEF

- Day 1: Thank you for doing such a great job today! We will be back every day this week to do this again with you. See you tomorrow!
- Day 5: Provide students their thank you bags
    - Thank you for spending the past few days with us learning and playing.

DAYS 2-4

FOLLOW SAME PROCEDURE MINUS VIDEO PORTION

Script for Control Group

DAYS 1 & 5

SIT PARTICIPANTS IN GROUP ACTIVITY AREA PROVIDED BY SCHOOL

- Today we will be watching an audio book story together as a class. Once the video is completed, we will do an activity together. If at any point you do not want to participate you can let one of your teachers know and go back to your regular classroom activity.
- Remember, when we listen to a story, we need to have our listening ears on, so let me see all of you put your listening ears on and catch a bubble.
- Pause story if too loud and remind students to listen.

SHOW VIDEO: https://www.youtube.com/watch?v=FhnYSh5I80g

- Great work everyone!

REFLECTIVE ACTIVITY

- Day 1:
    - Raising your hands, what are you grateful for?
    - Tomorrow we will begin a craft activity. We will have three days to work on it. Here is an example of what you get to make, a gratitude jar!
- Day 5:
    - Today is our final day together so we will watch our video again and finish by answering a final question: "What is your favorite gratitude item you included in your jar?"

DEBRIEF

- Day 1:
    - Thank you for doing such a great job today! We will be back every day this week to do this again with you. See you tomorrow!
- Day 5:
    - Provide students their thank you bags
    - Thank you for spending the past few days with us learning and playing.

DAYS 2-4

SHOW EXAMPLE, DO CRAFT ACTIVITY & HELP AS NEEDED

- Day 1 we watched a story about a gratitude jar and today you will get to make your own jars.
    - Hand children a jar, let them begin decorating.
- Day 2 we began creating gratitude items.

- Day 3 we worked on our gratitude jars more. Today we will be finalize these by adding pictures of what we are grateful for. In my jar, I have a picture of my family and ice cream. Those are two of my favorite things I am grateful for. What are you grateful for? You can draw it and add it to your jars.

Script for Go/No-go Task

ONE STUDENT AT A TIME (20-30 minutes each; offer a break in-between)

Today you will get to participate in two games. The first game is on my laptop (PC from lab). You will sit right here (on a chair in front of laptop).

GO/NO-GO TASK

- For this task you will see an underwater scene from deep below the ocean. As you know, there are many animals under the sea and some of these fisherman catch for us, others they avoid.
- Today you get to be a fisherman and catch all the fish you see on the screen by pressing this button here (space bar) to catch the fish in your net. Anytime you see a shark, you do not want to press this button (space bar). If you catch the shark, all your fish will escape your net!
- Let us try this five times to practice.

RUN 5 PRACTICE TRIALS

- Great work! Are you ready to play the game?

RUN 40 TRIALS

- Great work! You did really well on the game.
- Now, let's play a second game. This one will not be on the laptop.

Script for HSKT Task

- For this task you can stand right here (stand student up in front of you about two arms lengths)
- I am going to play a version of Simon Says with you, but it is called Opposite Simon Says.
- When I tell you to perform a task, let me say "touch your head", you will do the opposite, so touch your toes.
- Let us try this five times to practice.

RUN 5 PRACTICE TRIALS

- Provide 5 practice trials first as follows:
    - "Touch your head" → Child should Touch his/her toes.
    - Touch your head → Touch your toes
    - Touch your toes → Touch your head
    - Touch your knees → Touch your shoulders
    - Touch your shoulders → Touch your knees
- Great work! Are you ready to play the game?

RUN 10 TRIALS

- Tell the child these are the 10 rounds of the game now.
- As you instruct the child, take a note on how well they did for each trial via laptop spreadsheet.
- Score accuracy as
    - 0 pts. (*incorrect*)
    - 1 pt. (*self-corrected*)
    - 2 pts. (*correct*)
- Use the following in random order:
    1. Touch your toes → Touch your head
    2. Touch your knees → Touch your shoulders
    3. Touch your head → Touch your toes
    4. Touch your shoulders → Touch your knees

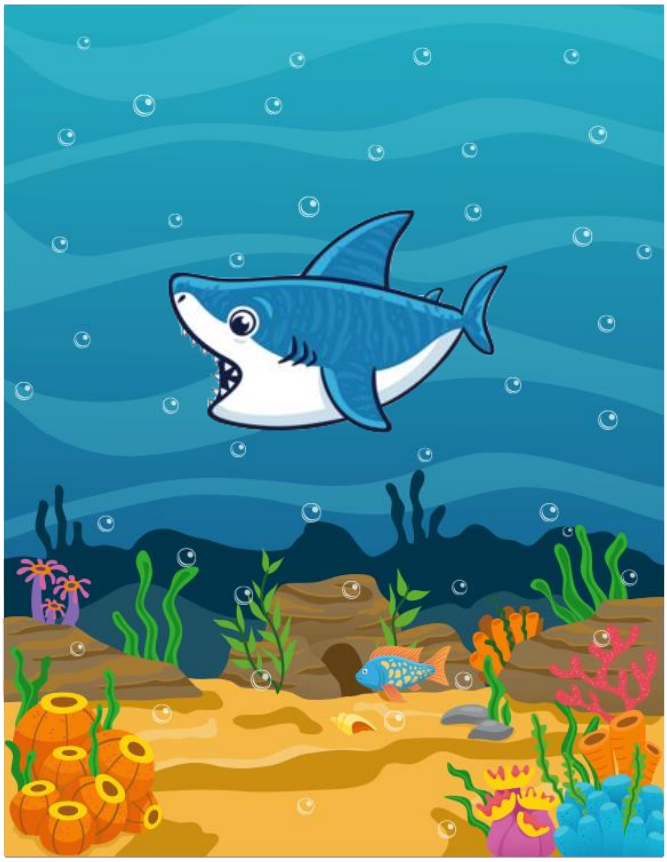
Control Activity:

1. Today we will be watching a video audio book together as a class. Once it is completed, we will do an activity together. If at any point you do not want to participate you can let one of us or your teacher know and resume regular classroom activities. If you do participate, we will begin by asking some questions about the video.
2. SHOW VIDEO & ASK QUESTION: What are you grateful for?
3. Tomorrow we will begin a craft activity reflecting on this video. We will have three days to work on it.
4. SHOW EXAMPLE, DO CRAFT ACTIVITY & HELP AS NEEDED
5. Day 1 will be decorating the jar. Day 2 will be creating gratitude items. Day 3 will be finalizing all items and adding as needed.
6. Today is our final day together so we will watch our video again and finish by answering a final question: “What is your favorite gratitude item you included in your jar?”
7. DEBRIEF on Friday and hand out compensation.

APPENDIX C

EXECUTIVE FUNCTION Go/No-go Task

Note: These are examples of the go stimulus (fish) and the no-go stimulus (shark) with the static background.



APPENDIX D

CONSENT FORM & DEMOGRAPHICS

Note: Form provided to caregivers as one document.

COLLEGE OF BEHAVIORAL & SOCIAL SCIENCE

DEPARTMENT OF PSYCHLOGY

Informed Consent
Executive Function & Self-Regulation in Preschool Age Children: Mindfulness Intervention

We are interested in the development of children's thinking in the preschool years. One of the things we are interested in is how children regulate their thinking and their abilities to focus on task-relevant information. We typically study this sort of thing by designing simple game-like experiments that children complete. We are working with the teachers and administrators at your child's school on this project and are requesting permission for your child to participate in one of these sorts of studies.

Purpose of the Study: The purpose of this research is to explore the potential benefits that brief intervention activities can have on children between three- to five-years of age.

Procedures to be followed: Participation in this research will involve completing a pre-test measure of attentiveness, participating in either a mindfulness intervention or control activity, and a post-test measure of attentiveness. The pre- and post-tests, will be administered as a motor activity and a computer game, which will be conducted individually, and will take five- to ten-minutes to complete (one on Monday and one on Friday). The intervention and control activities occur each day of the week for about 10-minutes in classroom groups.

Discomforts and Risks: The pre- and post-test will involve fine and gross motor skills, such as playing head-shoulders-knees-and-toes, causing some minor physical risk. Standard medical care procedures at the childcare center will be available in the event of injury but neither financial compensation nor free medical treatment is provided. Likewise, the attentiveness tasks may cause minor frustration. Your child's teachers will be available to provide comfort if needed. Breaks can be taken between tasks and participation can be withdrawn at any point.

Precautions will be taken in accordance with current Georgia Southern and local childcare center policies to reduce the risk of the spread of communicable diseases (including COVID-19). You have the right to request specific COVID-19 safety measures and we will accommodate as many as possible. Consenting to allow your child to participate in this research indicates your acknowledgement of the risk of disease transmission. You also acknowledge your requirement to notify the researchers in the event that your child tests positive for COVID within 5 days prior, are symptomatic prior to or at the time of participation, or receive a positive COVID test within 5 days after participation.

Benefits: The benefits to your child as a participant include gaining new skills in mindfulness tasks and having fun playing games. The benefits to society include furthering child development research in mindfulness interventions and child cognitive skill growth.

Duration/Time required from the participant: The study will be conducted all five days of one week (Monday to Friday), with about 15-minutes a day for the mindfulness task, and with an additional 15-minutes of participation Monday and Friday to complete the pre- and post-test attentiveness tasks.

Statement of Confidentiality: All data will be stored on locked PC laptops in a Georgia Southern University Department of Psychology research laboratory that only research team members may access. All data will be deidentified. All analyses will occur in this laboratory on these computers. Data will be stored in this secure location for three years following completion of the study.

1. Future use of data: You and your child will not be identified by name in the data set or any reports using information obtained from this study. All data will be subject to standard data use policies which protect the anonymity of individuals and institutions.

2. Right to Ask Questions: Participants and their guardians have the right to ask questions and have those questions answered. If you have questions about this study, please contact the primary investigator or researcher whose contact information is located at the end of this document. For questions concerning your or your child's rights as a research participant, contact Georgia Southern University Institutional Review Board at 912-478-5465 or irb@georgiasouthern.edu.

3. Compensation: There will be no compensation for guardians for this study. All participating children will receive a small goody bag at the end of the research, regardless of whether they completed the study.

4. Voluntary Participation: Participation in this study is voluntary and can be ended at any time by telling the research personnel. If your child wishes to not answer a given question or to not participate on a given day that is completely acceptable. Each child will be asked if they wish to participate before beginning a task and can let research personnel or their teacher know if they wish to not participate that day. The alternative to participating will be continued regular classroom activity with the primary childcare teacher.

5. Penalty: There is no penalty for deciding not to participate in the study. The child may decide at any time they don't want to participate further and may stop at any time with no consequence. Choosing not to participate or to withdraw will not affect their compensation.

6. There is one exception to confidentiality of which we must make you aware. In certain research studies, it is our ethical responsibility to report to appropriate authorities situations of child or elder abuse, child or elder neglect, or any life-threatening situation. However, we are

not seeking this type of information in our study, nor will you be asked questions about these issues.

7. I am asking your permission for your child to participate in this study and will provide him/her with a simplified verbal "assent" description before they participate in the study each day.

You will be given a copy of this consent form to keep for your records. This project has been reviewed and approved by the GS Institutional Review Board under tracking number H23237.

Title of Project: Executive Function & Self-Regulation in Preschool Age Children: Mindfulness Intervention
Principal Investigator: Dr. Ty W. Boyer, 912-478-5122, tboyer@georgiasouthern.edu
Other Investigator: Larissa Lamarca, ll12276@georgiasouthern.edu
Research Assistants: Arilyn Baldowski & Sydney Hudson

If you consent to your child participating in this research study, please sign your name, indicate the date below, and print your child's name below:

My Child's Name: _____ Child's Date of Birth: _____

Guardian's Name: _____

Guardian's Signature: _____ Date: _____

Demographics Questionnaire for
Executive Function & Self-Regulation in Preschool Age Children: Mindfulness Intervention

The purpose of this information is to get a clearer understanding of the overall average demographic makeup of the sample that data is collected from. As stated in the consent form, all data is deidentified and this information will be kept in a secure location at all times. You can refuse to answer any questions you do not wish to answer.

Please indicate answers by providing an "X" for multiple choices.

For example:

How are you today?
- o Happy
- ⊗ Excited
- o Sleepy

1. Provide your child's current age in years.
   - o 3 years of age
   - o 4 years of age
   - o 5 years of age
   - o 6 years of age

2. What is your child's ethnicity?
   - o White
   - o African American
   - o Asian
   - o Hispanic or Latino
   - o Native American
   - o Native Hawaiian or Pacific Islander
   - o Two or more
   - o Prefer not to say
   - o Other: _____

3. What is the primary language spoken in your home?
   - o English
   - o Spanish
   - o Portuguese
   - o French
   - o Mandarin
   - o Arabic
   - o Prefer not to say

- Other: _____

4. What is the most accurate description of your family makeup?
    - One-parent household, no siblings
    - Two-parent household, no siblings
    - Multiple caretakers, no siblings
    - One-parent household, with siblings
    - Two-parent household, with siblings
    - Multiple caretakers, with siblings
    - Prefer not to say
    - Other: _____

5. What is your annual household income?
    - Less than $25,000
    - $25,000 – $49,999
    - $50,000 – $99,999
    - $100,000 - $199,999
    - More than $200,000
    - Prefer not to say
    - Other: _____

6. What is the primary caretakers highest level of education?
    - Some High School
    - High School
    - Some college
    - Bachelor's Degree
    - Master's Degree
    - Ph.D. or higher
    - Prefer not to say
    - Other: _____