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Physical activity in the preschool classroom: An approach to enhance executive functioning through the Move for thought prek-k program

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Physical activity in the preschool classroom: An approach to enhance executive functioning through the move for thought prek-k program

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Lorraine Lanningham-Foster
Ann Smiley-Oyen

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this thesis. The Graduate College will ensure this thesis is globally accessible and will not permit alterations after a degree is conferred.

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DEDICATION

I would like to dedicate this thesis to my parents, Greg and Andrea Morse. My parents have believed in me throughout the entirety of my education and have pushed me to become my best in whatever I choose. I would not be here today without the endless amount of support of these two.

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In addition, I would like to thank the preschool classrooms for participating in the program, completing the teacher logs necessary for data collection, and allowing for classroom observations. Without their participation, this research and thesis would not be possible.

ABSTRACT

The purpose of this study was to assess the Move For Thought PreK-K Program activities on inhibitory control via response time and accuracy, as well as the level of feasibility, engagement, and program satisfaction. Eight preschool (3-5 years old) classes participated with four classrooms being randomly assigned to the early implementation group (intervention, N=52) and four classrooms to the late implementation group (control, N=51), whom would get to participate once the study was complete[61].

Prior to and following the cessation of the eight-week intervention, all children participated in the computerized day/night executive function task to assess their inhibitory control. The children's response times and accuracy were recorded on a program called audacity. During the intervention, teachers recorded the frequency, duration, and experience from the implementation of the activities with a daily teacher log. A sample of the lessons were also observed for fidelity purposes.

Results showed that over the eight-week intervention, the implementation of the Move For Thought Prek-K activities improved response time in children. After the completion of an ANCOVA on the post-test with the pretest as a covariate, there was a significant main group effect ($F= 7.20$, $p= .009$, $\eta^2= .08$). This signifies that the children in the intervention group were significantly faster during the post-test than the control group when controlling for the pre-test scores. The average duration of participation was 10 minutes, meaning that in a short 10-minute bout of physical activity, children's response times can significantly improve.

Further research should assess the effect of the Move For Thought activities on children's inhibitory control via response time and accuracy over a longer intervention

period. Given that the current intervention was eight-weeks, this may not be long enough to see the desired effects on executive functioning skills. Another limitation is that the fidelity checklists were completed by research participants in only a sample of the classroom activities among the intervention groups, rather than daily.

CHAPTER 1. INTRODUCTION

Childhood physical inactivity has been a topic of concern and most recently a large focus for research, as we see an alarmingly high number of obese children. Approximately 18.5% of youth and 13.9% of children ages two to five are considered obese[1]. That number may seem like nothing to worry about, until you consider that the number of children classified as clinically obese today has more than tripled since the 1970s[2].

Researchers are finding many contributing factors to childhood obesity besides being in a positive energy balance, which of course is a large determinant. Factors include changes in metabolism, genetics, environmental factors and environmental support of healthy habits, social and individual psychology, and physical activity and eating behaviors[3].

The issue with childhood obesity and why it is of such concern, is because of the impact it has on children at an early age and even into adulthood. Researchers have found that when a child is obese at such a young age, there is an increased risk for having additional chronic health issues such as poor bone and joint development, asthma, sleep apnea, type II diabetes, and a higher chance of developing heart disease risk factors[4,5]. Children who are obese are more likely to be obese as adults whom go on to develop additional risk factors for cardiovascular disease. These risk factors include high blood pressure, high blood glucose levels, dyslipidemia, etc.[6.] Children who are overweight or obese during their preschool years are five times as likely to be overweight or obese as adults compared to their normal-weight peers[7].

Research has shown that in as little as two generations, physical activity in the United States has decreased by 32% and Americans are expected to be half as active in the year 2030 as they were in 1965. This is largely due to the growth and industrialization the

United States has faced throughout the years, considering that physical labor has decreased tremendously. Research has shown that the faster an economy grows, the faster their population's physical activity declines[8].

According to research gathered by the Designed to Move campaign, physically inactive children have a higher risk of obesity, more missed school days, and lower testing scores. This cycle then continues into adulthood and affects their future children, as Griffith and colleagues found, children of inactive parents are 50% less likely to be active than their peers born into active families[9]. Thus, this leads to these children becoming adults whom earn less at work, have higher health care costs, more sick days, and a higher chance of premature deaths.

Along with the alarming health risks associated with being obese and/or physically inactive, another critical factor to consider is the development of executive functioning skills. The first few years of a child's life are the most crucial time for creating the foundation that will set them up for success related to life-long learning. According to an evidence-based article written by the Center on the Developing Child at Harvard University, executive functioning skills are not innate when a child is born, but are rather developed throughout the early years of their lives, specifically during the ages of 3-6[6].

It is also important to note that the gap can be filled between those whom possess strong executive functioning skills and those who do not. Referring to Kamijo, et al. (2011) the control group started out with better executive functioning skills than the intervention group, but the intervention group simply caught up after the intervention. This finding suggests that the gap can be filled and the children whom are behind can catch up to their peers[51].

Executive functioning skills are a group of control functions and mental processes that allow us to plan, remember instructions, focus our attention, and to be able to complete multiple tasks at the same time. Executive functioning skills are made up of three core skills that allow our brain to filter the nearby distractions, prioritize tasks, achieve goals, and to control impulses that may arise. They are mostly dependent on the prefrontal cortex and the neural circuit within that part of the brain[10,11].

The three core skills that make up executive functioning include inhibitory control, working memory, and cognitive flexibility. From those three core skills, higher-order skills are built onto that. Inhibition, or commonly known as self-control, is the ability to stay focused and resist temptations, and to also think before acting. Without inhibitory control, we would act immediately towards our external stimuli, internal impulses, and certain habits we have formed.

Working memory is the ability to hold information in the mind while mentally working with it. Examples of working memory include reasoning and problem-solving. Working memory is also the ability to remember a question one has while continuing a discussion, it is also holding something in mind that you were about to do, even when something else arises that requires attention first. Lastly, cognitive flexibility is the ability to easily switch focus from one task to another. For example, when problem-solving, it allows you to see something from different views when one way did not work.

Referring to the Review by Diamond and Lee (2011), executive functioning training appears to transfer, but the transfer is narrow. For example, working memory training does improve working memory, but does not seem to improve inhibitory control. Also, if training were to be more visual, this may not transfer to verbal skills[70]. The gains provided by the completion of martial arts is seen to improve a wider variety of executive functioning, as it requires the use of numerous executive functioning skills[16]. The most gains in executive functioning skills are not seen with exercise alone, but with exercise and character development such as traditional martial arts and mindfulness exercises[22].

A practical way to increase children's physical activity is to implement school and classroom-based physical activity programs. This is mainly due to the amount of time each day children spend in an academic setting[12]. A classroom-based program such as Move4Thought Pre-K & K focuses on increasing children's physical activity levels to help them meet the recommendations, while also improving executive functioning skills, school readiness, and motor skill development[61].

The Move For Thought PreK-K Program was mainly designed for children in the preschool environment, specifically children who are between the ages of three and six. The main objectives of the program are to assist in meeting physical activity needs, improving physical literacy and fundamental gross motor skills, and practicing physical, social, cognitive, and emotional skills that are necessary for a child's development[61].

Since teachers are possible barriers to implementation of physical activity in the classrooms, programs must set them up for success. Common reasons classroom-based physical activity programs fail is because they do not provide teachers with enough information on how to implement, they lack support for the teachers, and the equipment necessary is not provided[13]. This is especially important, because by doing so, it will increase teachers' self-efficacy related to implementation. It is known from previous research that the most common complaints teachers have is the lack of support from their immediate environment, not enough space to perform activities, and a lack of training[13].

The Move For Thought PreK-K activities provide ways that teachers can incorporate physical activity into their daily routines without interfering with their academic goals and curriculum. It is necessary for children to learn how to move their bodies and perform fundamental body movements, which will set them up for success in the future relating to being physically active. The program provides teachers with tips and management strategies for a smooth and easy implementation.

To avoid feelings of negativity towards physical activity, Move For Thought PreK-K focuses on team and individual goals rather than competition. If a child is asked to do their best each time and rewarded for the effort versus the outcome, there will be more positive feelings towards physical activity. The rewards can be tangible such as stickers or pencils, but can also be something as simple as positive verbal feedback.

The purpose of this thesis is to examine the feasibility of the activities and the effects that the Move For Thought PreK-K program has on executive functioning skills, specifically inhibitory control. Move For Thought PreK-K is a newly developed program and has not been evaluated.

CHAPTER 2. LITERATURE REVIEW

Benefits of Physical Activity on Executive Functioning

An interesting point to make is that those who need the most improvement in their executive functioning skills (EFs), benefit the most with training[14,15,16]. There is a strong need to narrow the gap between children who are lacking executive functioning skills and those whose executive functioning skills are strong, as they are found to predict school readiness, later academic achievement, and mental and physical health[66,67,68,69]. By working with children who need to further develop their executive functioning, we can level the playing field so to speak[65].

There are many benefits that children will experience when becoming physically active. The benefits are physically, emotionally, cognitively, and socially related. Children will become more aware of their bodies and increase their physical literacy, they will deal with their emotions such as stress and anger in a better way, they will learn better and be better prepared for their academics, and they will socially interact with their peers and teachers in a positive way, developing relationships.

First, it is important to note that children's executive functioning skills need to be continuously challenged throughout training[17,18,19]. This is crucial because as we know, if someone is not challenged, they may stop improving. Also, if executive functioning skill tasks are not increasing in difficulty each time a child improves they may become bored, as the material may now seem too easy. The largest differences between the intervention groups and control groups were shown on the most difficult executive functioning tasks. This is important to note, as the differences only appear when the children are challenged to achieve their fullest potential[20,21,22].

Along with increasingly difficult tasks following improvements, repeated practice is key to executive function development. Executive functioning skills are shown to improve the most when they are continuously worked on throughout the day, compared to one single bout of time[21,23,24]. From previous research we also know that training verbal working memory does not clearly transfer to written working memory[17]. This in turn supports the need for activities that require a diverse amount of executive functioning skills practice to successfully improve them in children. Studies have demonstrated that executive functioning skills diminish after practicing ends, typically months to years after[19,25,26].

Time is also a crucial factor when considering improvements in executive functioning skills. Even when dose and frequency are kept constant, it was found that the longer the duration (in weeks) was, the more gains in executive functioning were seen[27,28,29]. Another study that specifically measured the effect of duration found the same outcome. The more days the intervention lasted, the better the results were related to executive functioning skill development[30].

How an exercise program is implemented also effects the development and improvement of executive functioning. The same program implemented in different settings may or may not be successful solely based on whether the environment is supportive or not. If the person leading the program is committed and strongly believes the outcome to be positive, there is a much higher chance that the program will work[21,31]. On the other hand, if the person leading the program feels no support and does not believe in the efficacy of the program, it will most likely be unsuccessful[32].

The Effects that Exercise has on the Brain

According to the review by Vazou S. et al, (2016) there are many physiological benefits of exercise, specifically to the brain. Exercise has been shown to increase neurochemical production of two important neurotransmitters that regulate mood and behavior, dopamine and norepinephrine[34]. In children with ADHD, the alteration in the levels of these neurotransmitters is associated with a reduction in ADHD symptoms and overall improvements in their executive dysfunction[33]. Exercise has also shown to aide in the upregulation of growth factors and neurotrophins, specifically the upregulation of brain-derived neurotrophic factor (BDNF) and the formation of new blood vessels[34]. Previously mentioned when discussing executive functioning skills and the involvement of the pre-frontal cortex, exercise is shown to activate the pre-frontal cortex and stimulate structural changes in the hippocampus and cerebellum while also increasing cerebral blood volume[34]. The pre-frontal cortex, unlike any other areas of the brain is the last to mature, and matures into the 20's. Knowing this, when a child is rapidly growing it is a critical time when myelination and synaptic pruning take place and are driven by the child's experiences[35].

There is evidence of a decrease in gray matter volume of the brain in adults who are obese. Not only are adults' brains affected by obesity, but when a child is obese it can affect the way the brain develops as well. Research found a correlation between obesity and the development of executive functioning skills. Stice, et al., (2010) found that children who are obese had higher activation levels of both the dorsal striatum and orbitofrontal cortex[10]. Thus, this suggests that this area is working harder to suppress chronically hyperactive appetite-stimulating areas. This also supports the observation that many children who are obese lack self-control and inhibition which requires the proper use their prefrontal cortex[10].

Considering that the prefrontal cortex is the last part of the brain to develop, it is very fragile to stressors such as obesity. Research suggests that an increase in childhood obesity leads to a decrease in academic performance given the effects obesity has on executive functioning skill development and academic success. Children with poor inhibitory control at age 2 were shown to have higher BMIs by the age of 5 and those with poor inhibitory control at ages 3-5 showed higher BMIs into pre-teen years, with the most rapid weight gain at age twelve[36].

Types of Physical Activity that Improve Executive Functioning Skills

There has been various research on the positive role physical activity can play in children's executive functioning, and the type of exercise that impacts it the most. It is crucial to note that not all exercise affects the development of executive functioning skills in the same manner. Knowing this, it is important to identify which type of exercise is the best to choose when wanting to improve the development of these skills in children.

Previous research looks at the effects of both chronic and acute aerobic physical activity on executive functioning skill development. Whether each type of aerobic exercise benefit those skills the same, was the topic of discussion. It was found that when an exercise is more cognitively engaging, the effect on executive functioning is larger[37].

Many of the activities that children participate in require cognitive engagement, as they are usually working in groups and must work with and anticipate the actions of their peers and/or teammates. Activities like soccer and tag require children to create, monitor, and modify a plan in order to meet demands[38]. Taking this into consideration, aerobic games and executive functioning tasks require the child to think in a similar way and the skills acquired during aerobic games could possibly transfer to executive functioning tasks.

When aerobic running that is increasingly difficult over a period of time is compared to a standard physical education class over a 12-week period, there was an improvement in only one of the executive functioning skills, cognitive flexibility[39]. The children's flexibility and divergent thinking were assessed by asking children to name as many appropriate uses of a specific object, in this case it was a hammer. Hinkle and colleagues observed the effects of a similar running program compared to a control group. The results showed that the children in the running group performed better on Torrance Test of Creative Thinking which measures flexibility and divergent thinking as well. The measures of flexibility and divergent thinking tap into the development of executive functioning[40].

Additional evidence supporting the notion that executive functioning is sensitive to aerobic training was shown by comparing overweight children in aerobic interventions and control group. Davis et al. (2007) randomly assigned overweight children to either a 40-minute, 20 minute, or a no exercise control group. What was found is that the aerobic training had positive effects on tasks requiring executive functioning skills and also marginal positive effect on mathematics. These gains were attributed to the increase activation of the children's pre-frontal cortex[41].

As for acute exercise, the tasks requiring frontal-dependent cognitive process specifically for executive functioning showed greater improvement in executive functioning overall. Budde, et al., (2008) randomly assigned children to either a 10-minute exercise that involved a series of coordination tasks or to a 10-minute bout of non-coordinative tasks that consisted of more repetitive movements and tasks. What they found was that the children assigned to the more challenging exercise, requiring bimanual skill coordination, performed better on task accuracy and completion time on selective attention tasks. This is attributed to the activation of the prefrontal cortex, whereas the more repetitive movement exercises do not require[42].

A study conducted by Vazou & Smiley-Oyen (2014) showed the positive effects of exercise on executive functioning via response time in an executive functioning task emphasizing inhibitory control. What was found is that after a single 10-minute bout of moderate aerobic physical activity that was also cognitively engaging (combined with math practice) improved children's response time[65]. The cognitively engaging aerobic activity included both coordinative and complex motor skills.[65]

It is consistently found that people of all ages, and specifically children, who are more active and have better aerobic fitness, tend to have better executive functioning skills than their sedentary peers. This could be due to the individual's joy of having a choice of the activities they prefer and take pleasure in. It is known that the cognitive benefits related to exercise is somewhat related to the joy the individual experiences[43,44,45,46].

It has been found that exercise, either chronic or acute, has a positive impact on cognition in children. It does depend on whether that exercise is qualitative (skill learning, requiring high cognitive effort and based on mental engagement) or quantitative (requiring minimal skill and is more repetitive movements such as cycling). While both seem to benefit, the more qualitative activities improve children's cognitive function if they are cognitively engaging, which is believed to improve academic performance[47].

Before exercise was thought to improve executive functioning skills, previous published research has shown to improve executive functioning skills used computerized training. The computerized training system known as Cogmed showed obvious improvements in working memory and reasoning. These improvements were evident even on untrained tasks. The improvements remained 6 months after the training, thus showing success with the computerized program[19,48]. With Cogmed, 6 months after the intervention, there was an improvement in math as well despite the lack of immediate math gains[18].

Despite the success with working memory, reasoning, and delayed math improvements using computerized training and games, there is still no evidence that this form of training improves inhibitory control in four to six year-old children. This leads us to consider physical activity. Physical activity alone has not been found to improve executive functioning, but rather in combination with character development. Lakes and Hoyt (2004) conducted a study with five to eleven-year-old children by randomly assigning them to a traditional physical education class and a tae kwan do. They found that children in the tae kwan do group showed better working memory and inhibitory control[16]. Yoga, similar to tae kwan do as they both require sensory awareness and relaxation. has been shown to improve planning and all three of the core executive functions[22].

Previous research shows that activities that require physical conditioning and also character development and self-control led to improvements in social ability and self-esteem, while also showing less aggression in the children[49]. These differences were shown in the comparison of traditional tae kwon do, which emphasizes physical conditioning, character development, and self-control, versus modern martial arts, which focuses solely on the physical aspect.

The mechanisms of increasing physical activity levels include physical mechanisms and also cognitive mechanisms. The physical mechanisms include a change in aerobic capacity, muscular strength (more specifically bone strength for children), and body composition. For cognitive mechanisms, physical activity is shown to increase blood flow specifically to the cerebrum, increase brain derived neurotrophic factor (BDNF), increase expression of dopamine, and develop new neurons in the hippocampus.

Research by Diamond found that interventions that are most likely to increase executive functioning in children are those that will train and challenge diverse motor skills and executive functioning. It was also apparent that those activities that brought children joy and self-confidence, while also giving them a sense of belonging positively, impacted executive functioning development[50].

Motor Skills

Motor skill development is a crucial factor to consider when increasing physical activity levels and ensuring academic readiness in children. Having good motor skills helps children explore the world around them, thus improving their cognitive development. Motor control is crucial for children's growth through their adolescent years and later into adulthood by helping them to gain their independence. There are two types of motor skills, gross motor skills which involve large muscle groups to allow one to throw, run, climb, etc. There are also fine motor skills which refer to small movements and allow a child to grasp small objects such as picking up a cheerio with their index finger and thumb.

Researchers have found that not only are executive functioning skills a determinant of school readiness, but there is an association between school readiness and motor skill development as well[51]. A longitudinal study found that children who mastered motor skills, both fine and gross, attained higher reading levels by third grade[52]. More specifically, there was a stronger correlation between academic success/readiness and fine motor skill mastery. Children who successfully mastered the development of fine motor skills showed more success in mathematics prior to kindergarten entry and also showed stronger gains throughout the year[53].

Previous review work by Diamond found that tasks that activate the prefrontal cortex, which are associated with executive functioning, also activate critical areas of the brain for motor processing, specifically the cerebellum. The prefrontal cortex and the cerebellum are found to be dependent on one another, thus indicating that if one is impaired, there is a strong chance that the other area of the brain suffers as well. Diamond also found that the reasoning behind children with cognitive disorders also being diagnosed with learning disabilities is due to correlation between cognitive disorders and motor development. Lastly, it was found that executive functioning skills regulate motor and cognitive skills[54].

Physical activity and motor skill development

There are three subtypes of body movements that children will be able to master with the development of motor skills. The first body movement is locomotion, which is required to move from one place to another such as running, jumping, hopping etc. The second is manipulation, which consists of throwing, kicking, catching, dribbling, and striking. Lastly, there is non-locomotor, which is when the body moves from a relatively stable position such as twisting, turning, pushing, balancing, and shaking.

Research has shown that children whose motor skills are more developed, participate more in moderate to vigorous exercise than their peers whose motor skills are underdeveloped[55]. These children spend less time in sedentary behavior. Children's activity was monitored over a period of seven days and an average of 12.7 hours per day. It was found that children whose motor skills are more developed spent 2% more time in moderate physical activity and 1.2% more time in vigorous activity, which translates to 12 more minutes of moderate and 2 or more minutes in vigorous[56].

CHAPTER 3. METHODS

Participants and Setting

This study was conducted over an eight-week period using eight preschool classes, four assigned to the intervention group (from one center) and four to the control group (from two centers). All preschool centers provide full-day early care and are located in a midwestern college town. The children's ages in each of the preschool classes ranged from three to six. With each piece of data collection, students gender along with an individual code specific to them was recorded (no names were used in this study). Each class, which were all taught by female teachers, had on average 13 children. Eight classes participated in the study, four classes (n= 52) were randomly assigned to the early implementation intervention group and four classes (n= 51) were assigned to the late implementation control group as shown in Table 1. Of the students in the early intervention group, 23 students were female and 29 were male. Out of the control, 31 of the students were female and 20 were male.

Table 1. Demographic of Children by Group, Gender, and Age Category.

		N (total)
Group	Intervention	51
	Control	52
Gender	Male	49
	Female	54
Age	< 4 years old	27
	≥ 4 years old	76

Measures

Measurements specific for this thesis were the day/night task on the computer, teacher logs, and fidelity checklists. Executive function skills were measured with the computerized day/night task, fidelity was measured with the fidelity checklists, and level of implementation was measured by the completion of daily teacher logs. The day/night measurement was used to measure inhibitory control in children pre-and post-intervention by recording their accuracy and response time.

Day/Night Task

To measure inhibition related to executive functioning skills, the day/night task was administered pre- and post-intervention. This is a computerized game requiring the child to use their inhibitory control skills by thinking before acting and without answering impulsively. The test includes two pictures, a picture of a sun and a picture of a moon, and the children are asked to remember one rule and say the answer. Specifically, when a picture of a moon was shown on the screen, the children were supposed to say day and when a picture of a sun was on the screen they were supposed to say night.

The children were given two practice trials and 16 testing trials. If the practice trials were missed, children were allowed up to three practice rounds. If the first practice answer was wrong, the rule for that specific picture was immediately explained once more. If either practice trial answers were wrong, both rules were repeated. If a child began the testing with two or more wrong answers and they had not used all practice trials, the test was stopped, and they practiced until beginning the test once more. The pictures stayed on the screen until the child answered and the trials were advanced by the experimenter. In total, there were 16 trial numbers for the day/night task that were recorded for data collection in the pre- and post-test.

The correct number of responses were recorded on the computer by the researcher when the answer was provided. Using audacity, the answer was recorded, and the response time was measured by selecting the duration from the audio signal that appeared when the response was given by the child. The average response time as well as accuracy from all 16 trials was calculated and outliers were eliminated. The rules and implementation of the computer game is shown below (APPENDIX 6).

Teacher Logs for Implementation Data

Each teacher was given a teacher log during their time using the Move For Thought PreK-K program. The log is a part of the program evaluation and its purpose is to obtain information on how the teachers used each activity over the eight-week period. Before the teachers involved in the early implementation intervention group completed teacher logs, they were given a teacher checklist (APPENDIX 3).

Teachers were asked to complete at least one activity per day during the school week and to record that specific activity. Multiple activities could be completed each day if desired, and the teachers were provided with extra logs for this reason. The activities (APPENDIX 2) were categorized as either a large group, small group, outdoor, or a transition activity and could be used more than once if desired. The teachers were asked to log how many children participated, if they used music or any supporting files from Move For Thought PreK-K, the time spent on the activity, if they were satisfied with the activity, as well as if the students were satisfied. Satisfaction was ranked on a scale from 1-5 (1 being very unsatisfied and 5 being very satisfied).

The level of physical and cognitive engagement for each activity was recorded on a scale of 1-3 (1 being not at all, 2 being a little, and 3 being very). At the end of the teacher log there was a place for teachers to express any challenges that arose during the activity. If there was no school that day due to a planned no school day, field trip, or early dismissal, the teachers were asked to record that and to leave that day blank. A one-week example of a teacher log is shown (APPENDIX 4).

Fidelity Checklists

The fidelity checklists were completed by a research assistant while observing a sample of activities among the intervention classrooms, to ensure proper implementation. While the teacher was performing an activity with their students, the research assistants monitored the activity. During each activity there were requirements such as the completion of at least one complex movement, cognitive engagement, self-control, and social and emotional development. It was also a requirement that children had a choice and felt a sense of autonomy, that they were given enough time for repetition and practice (at least 30-seconds for a move and 3-5 attempts), and that the activity required the completion of fundamental skills.

Complex moves include bimanual coordination tasks such as walking backwards, mirroring, hand-eye coordination, etc. Cognitive engagement includes any activity that requires children to use their imagination, to ask questions, and to remember more than one rule. Self-control tasks include activities that require children to wait for a signal to start and stop, and inhibition tasks such as Simon says which requires children to ignore irrelevant stimuli.

Activities that targeted social and emotional development included dancing, expressions, respecting each other's space, taking turns, and sharing equipment. The children were given choices, allowing them to explore activities to feel autonomous. Lastly on the checklist was whether fundamental skills were used during the activity. Fundamental skills were checked off when an activity consisted of locomotor (walk, march, run, gallop), non-locomotor (balancing, rolling, twisting), and manipulative movements (tossing, catching, dribble, bounce). An example of the fidelity checklist completed by the researcher assistants is shown (APPENDIX 5).

Procedures

Participation among each school was completely voluntary. Schools were recruited through Team Nutrition using a flyer that included information about what the intervention would entail. For each school that participated, there was a compensation of $150 per classroom. The intervention study was exempt by Iowa State University IRB (APPENDIX 7), as no child's name was mentioned and only a specific code unique to each child was used for data collection.

Teachers were asked to complete at least one activity each day and record their experience in the teacher log provided. Each activity could be used more than once if desired and more teacher logs were provided for this reason. Periodically, research assistants and those involved in data collection visited a sample of the activities to complete fidelity observation checklists.

The intervention lasted eight weeks with pre-testing taking place in September/October and post-testing eight weeks after implementation, around November/December. For the late implementation control group, they were told at the beginning of the intervention that they would be able to start in January. Before the early implementation intervention group began, the teachers and all of the classrooms involved were given the supporting files. The timeline for the eight week implementation is show below (Figure 1).

During the intervention, the Move For Thought Program was implemented in the four intervention classrooms, otherwise known as the early implementation intervention group. There was a table of activities given to the teachers and separate, in depth descriptions of each activity. Each activity had a specific title, tips on the recommended space for implementation, management tips such as music and books that paired well with the activity, teaching tips to promote successful completion of activity, choices for children, and information on how the activity is strengthening executive functioning skills. There were also tips on how to promote a positive environment and ways to increase difficulty if needed.

Prior to and after the intervention, the day/night task was administered as a way to measure inhibitory control of executive functioning. Each student had the choice on whether they wanted to participate in the day/night computer game, but were given a sticker if they did complete it. The computerized test was administered in a quiet and secluded room, free from distractions to the extent that was possible, as children could not leave the classroom in some centers. The child was facing away from any peers that were also in the room at the time of testing to avoid further distractions. Each child that participated was required to wear a headset that blocked out any noise and recorded their answers and response times.

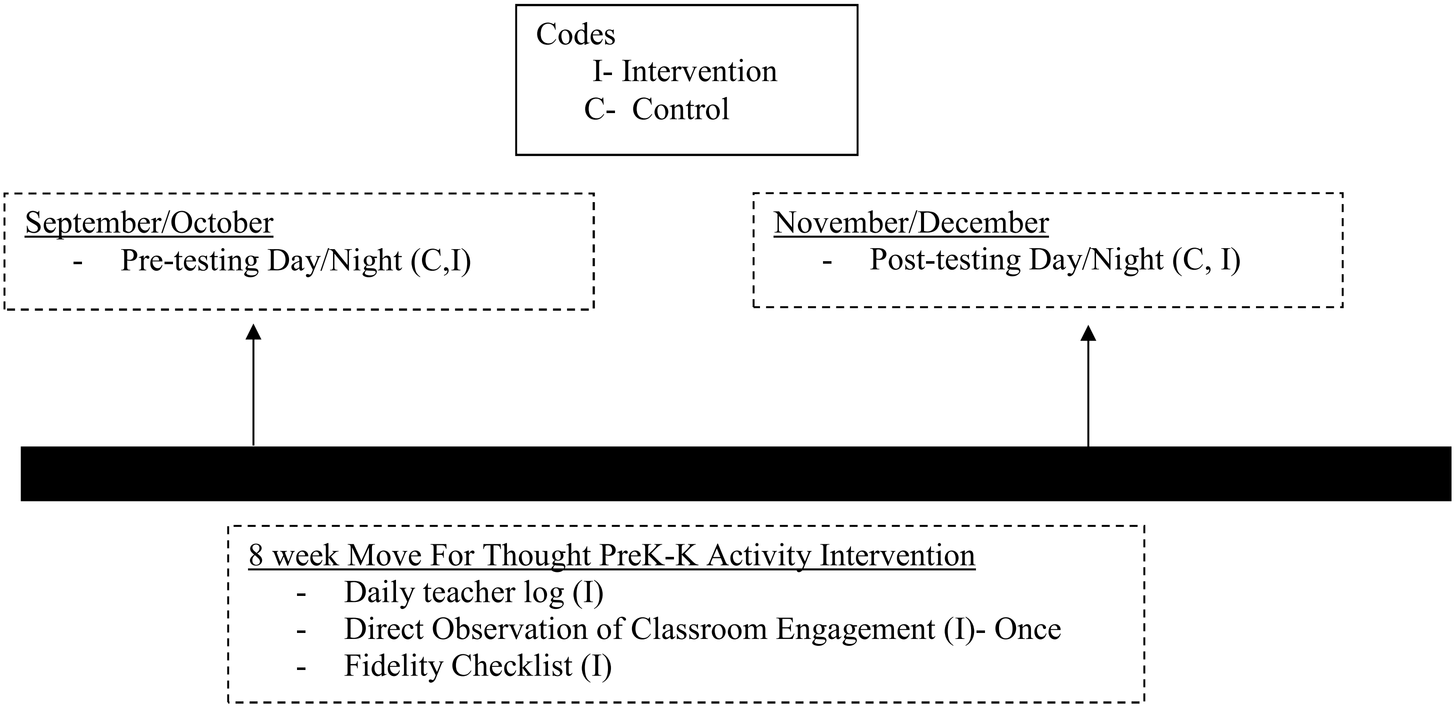

Figure 1. Timeline and outline of the Move For Thought PreK-K Program

Data Analysis

Using SPSS software, the data was examined between groups for accuracy, response time, and a Z-score which was not a standardized formula. From the day/night task, response time and the number of correct answers were recorded, where a Z-score was created from the two. The Z-score adjusted the number of correct answers with the response time of those answers that were accurate. The formula for the Z-score was created by taking the [(average response time of the accurate answers *16 total trials) / the number of correct answers]. The teacher log data was analyzed using Excel.

Chapter 4. RESULTS

Day/Night Task

Accuracy

A repeated measure analysis of variance (ANOVA) was conducted on accuracy of the day/night, with time (pre, post) as the within subject factor and group (intervention, control) as the between subject factor. Results showed a significant time effect ($F=7.46$, $p= .007$, $\eta = .07$), but no significant interaction effect on accuracy. These results mean that no matter the group, all children improved in accuracy from pre-test to post-test (Figures 2 and 3). The accuracy score was the number of correct answers out of the 16 trials that were recorded. SD for the pre-test = 4.66 and 4.08 for the post-test.

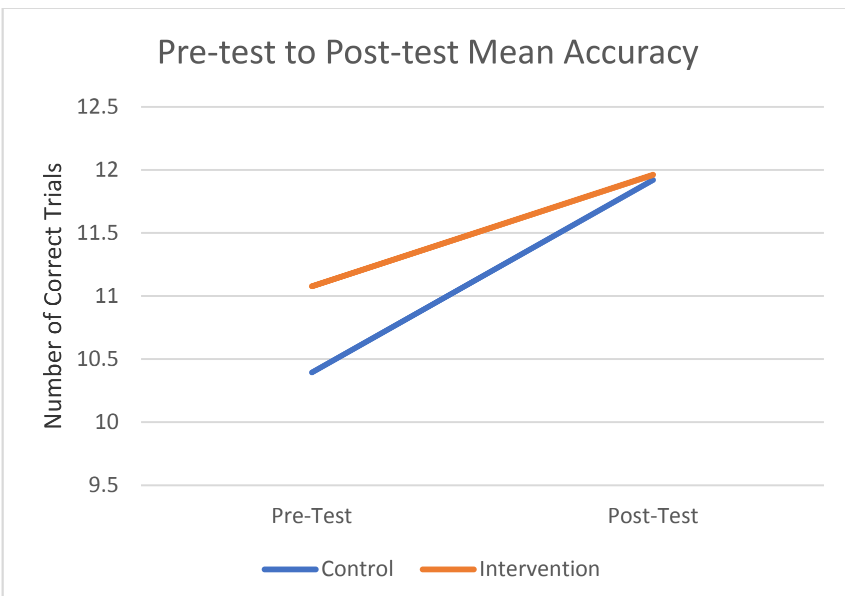

Figure 2. Improvement in accuracy from pre-test to post-test in both the control and intervention.

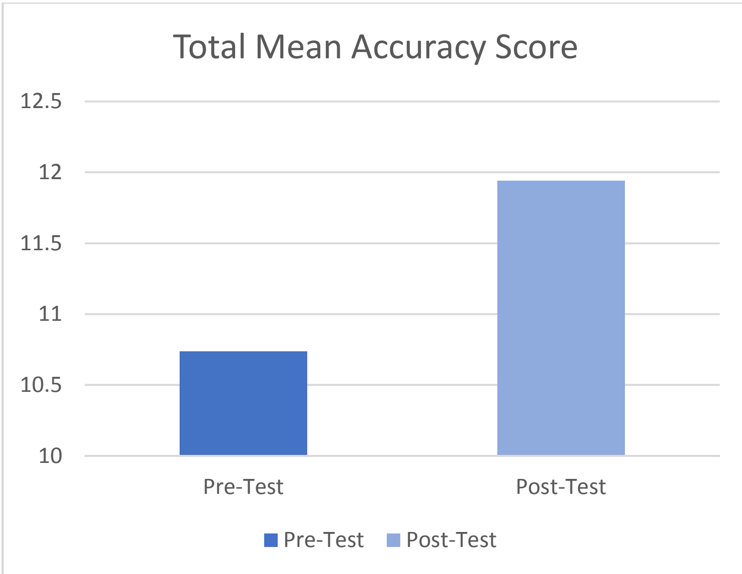

Figure 3. Total mean accuracy score of all children from pre- to post-testing when combining each group and each gender.

The analysis was repeated with gender being included as the between-subject factor, with no significant interaction. However, there was a significant difference between boys and girls, regardless of group or time, with girls being more accurate than boys ($F=3.92$, $p=.05$). A representation of the total mean comparisons of gender is shown in Figure 4 and 5. Descriptive statistics are shown in Table 2.

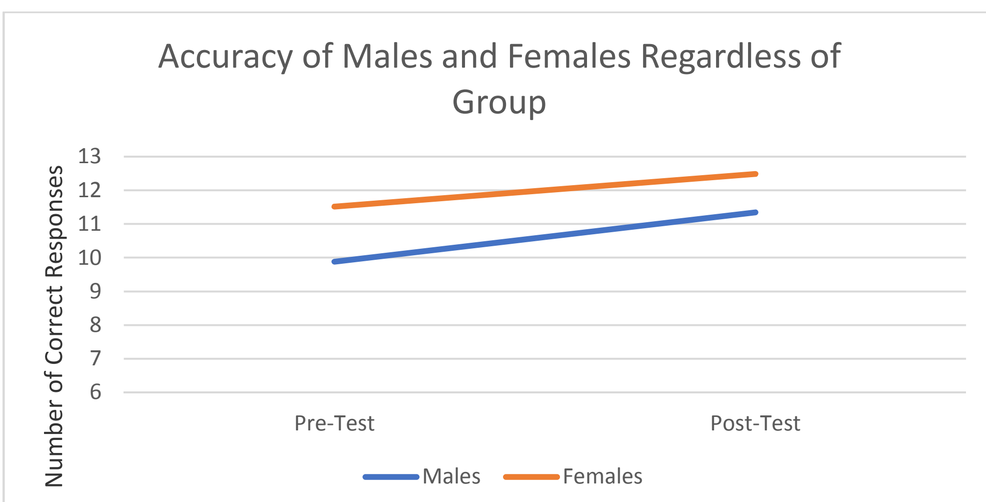

Figure 4. Accuracy of the total number of females compared to total number of males regardless whether in the control or intervention group.

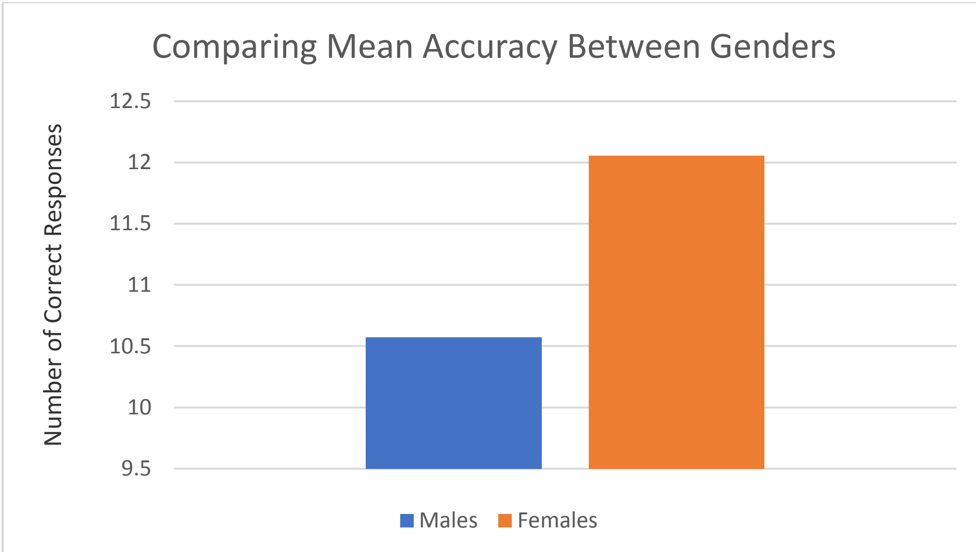

Figure 5. Mean post-test accuracy results when comparing males to females.

Table 2. Descriptive Statistics of Day/Night Accuracy Pre- and Post-Test Between Genders

	Group	Gender	Mean (SD)
Day/Night Accuracy Pre-test	Intervention	Female	12.22 (3.91)
		Male	10.17 (4.84)
	Control	Female	11.00 (4.65)
		Male	9.45 (5.05)
Day/Night Accuracy Post-test	Intervention	Female	12.65 (3.92)
		Male	11.41 (4.40)
	Control	Female	12.35 (3.34)
		Male	11.25 (4.87)

Similarly, a repeated measure ANOVA with time as the within-subject factor and age as the between-subject factor was conducted, and there was no significant interaction within group. There was however, a significant difference found by age as a categorical variable

(F=4.40, p= 0.38, η2= .04). The children were grouped based on two age categories, one group being under the age of four years old and one group four years old and above. What was found is that younger children were less accurate than the children four years and older (Figures 6 and 7) even from pre-test to post-test (Figure 8). Descriptive statistics are shown in Table 3.

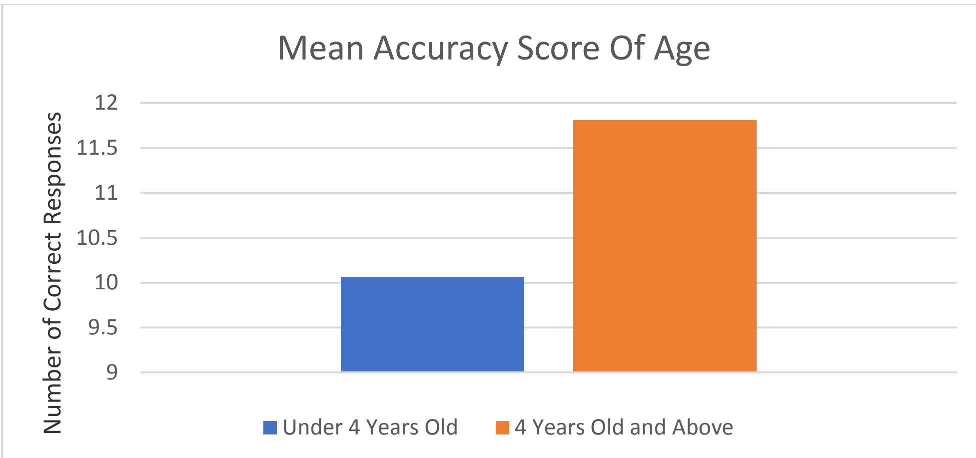

Figure 6. Comparing the mean accurate responses of children under the age of four years old to those whom are four years old and above.

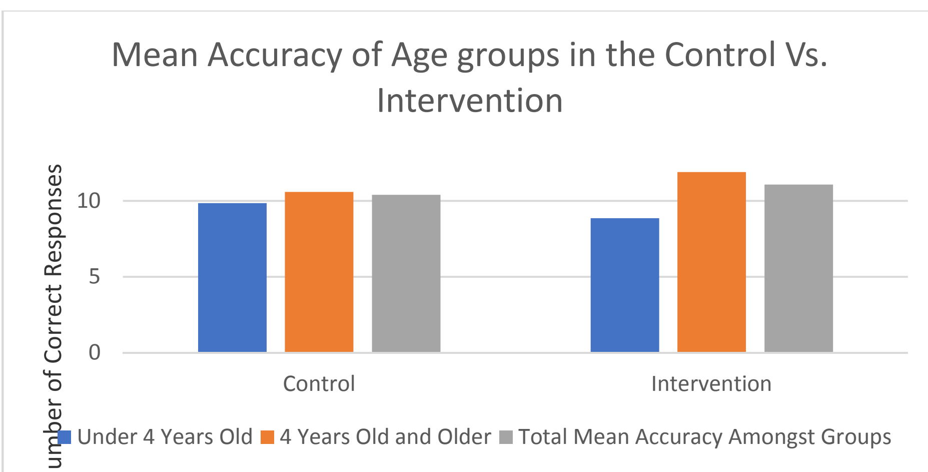

Figure 7. Mean accuracy of the two age groups between the control and intervention as well as the average of the two age groups between intervention and control.

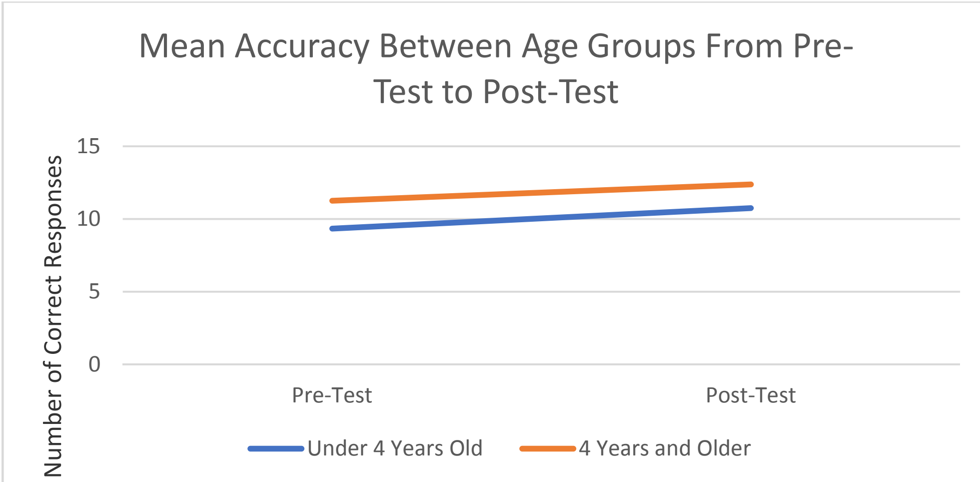

Figure 8. Correct responses of the two age groups between pre-test and post-test

Table 3. Descriptive Statistics of Accuracy Among Age Groups Between Intervention and Control.

	Group	Age Category	Mean (SD)
Day/Night Accuracy Pre-test	Intervention	< 4 years old	8.86 (5.88)
		≥ 4 years old	11.89 (3.68)
	Control	< 4 years old	9.84 (5.24)
		≥ 4 years old	10.58 (4.73)
Day/Night Accuracy Post-test	Intervention	< 4 years old	10.07 (5.05)
		≥ 4 years old	12.66 (3.67)
	Control	< 4 years old	11.46 (5.24)
		≥ 4 years old	12.08 (3.55)

Response Time

A repeated measure ANOVA was completed with time as the within-subject factor and group as the between-subject factor. From this ANOVA, no significant interactions were found. There was however, a significant time effect ($F=48.53$, $P= < .001$, $\eta 2 = .37$). To account for the difference in pre-test scores among the groups, the analysis was repeated where the pre-tests were then controlled for. An ANCOVA was completed on the post-test with the pretest as a covariate. From this measurement, there was a significant main group effect ($F= 7.20$, $p= .009$, $\eta 2= .08$) meaning that the children in the intervention group were significantly faster during the post-test than the control group when controlling for the pre-test scores (Figures 9 and 10). Descriptive statistics of post-test response times are shown in Table 4.

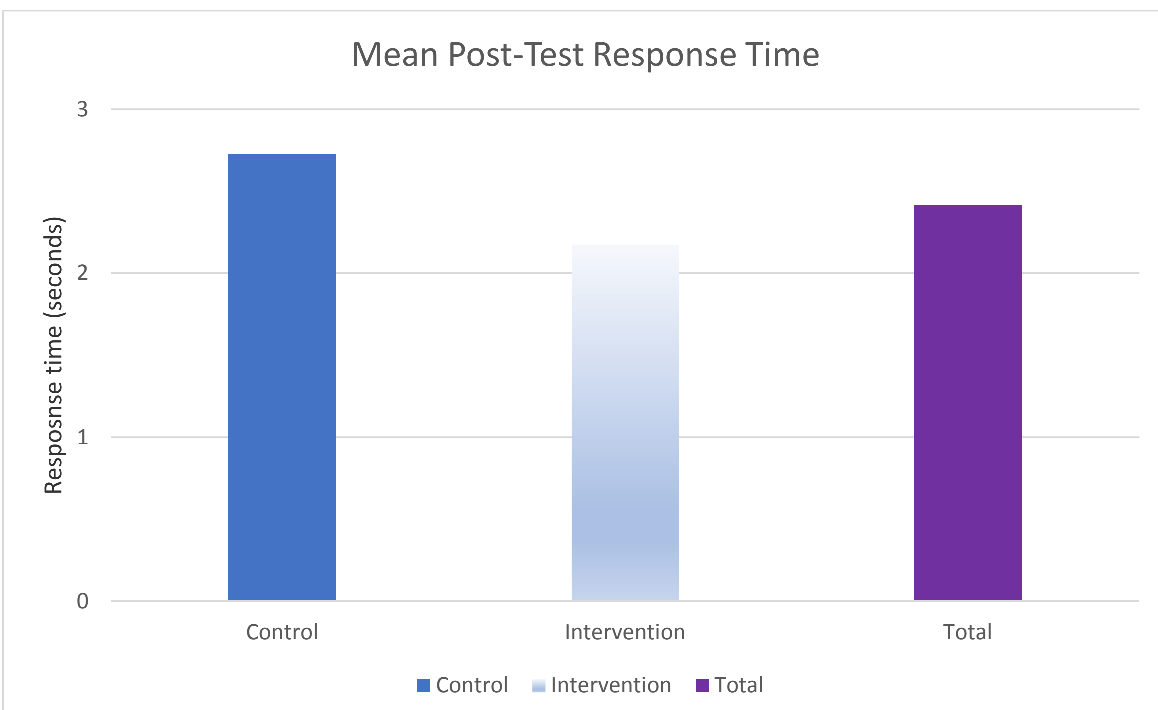

Figure 9. Mean response time of the post-test when controlling for the pre-test scores amongst the control and intervention.

Table 4. Post-Test Response Time Descriptive Statistics

Group	**Mean** (seconds)	**Std. Deviation**	**N**
Control	2.72	1.04	37
Intervention	2.17	.81	49

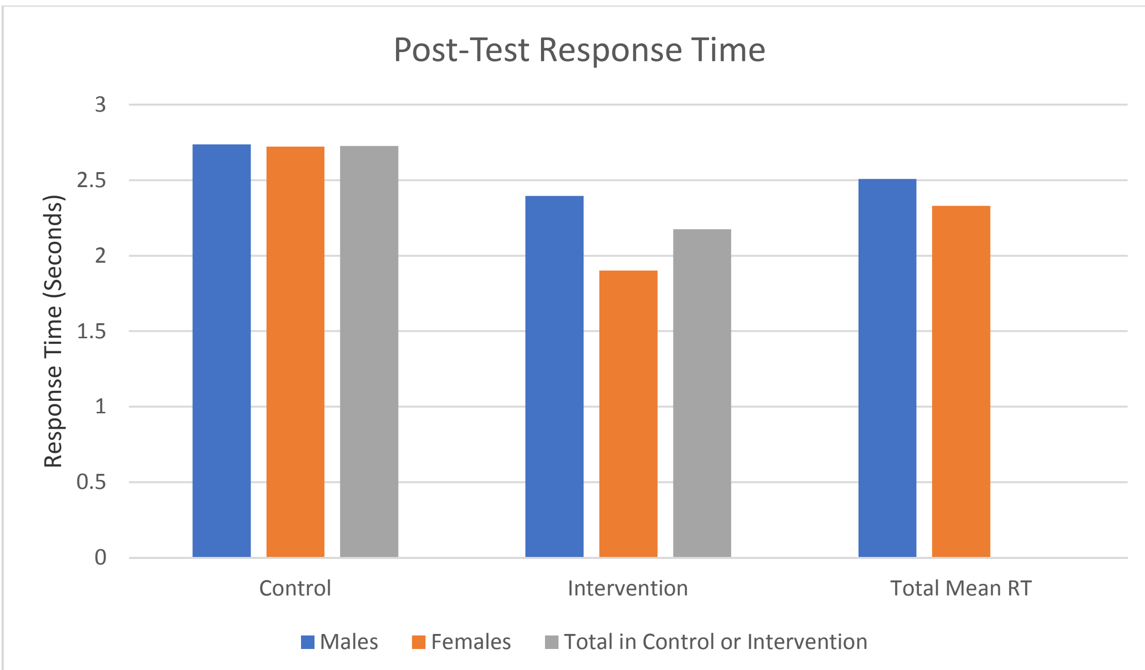

Figure 10. Mean post-test response time of males and females in either the control of intervention, along with the gender combined in each group.

A completion of an ANCOVA on the post-test with the pre-test scores and age as a covariate did not change the results of the response times. There was still a significant main effect of group (F=6.39, p=0.13, η2= 0.72). Given that the results did not change; age was not a significant covariate. The same ANCOVA analysis was run on the post-test with the pre-test as a covariate but this time the gender as the between-subject factor. Again, there was not a significant interaction, as results remained the same (F=7.61, p=.007). It is interesting to note however, that girls were faster than boys in their responses (Figure 11).

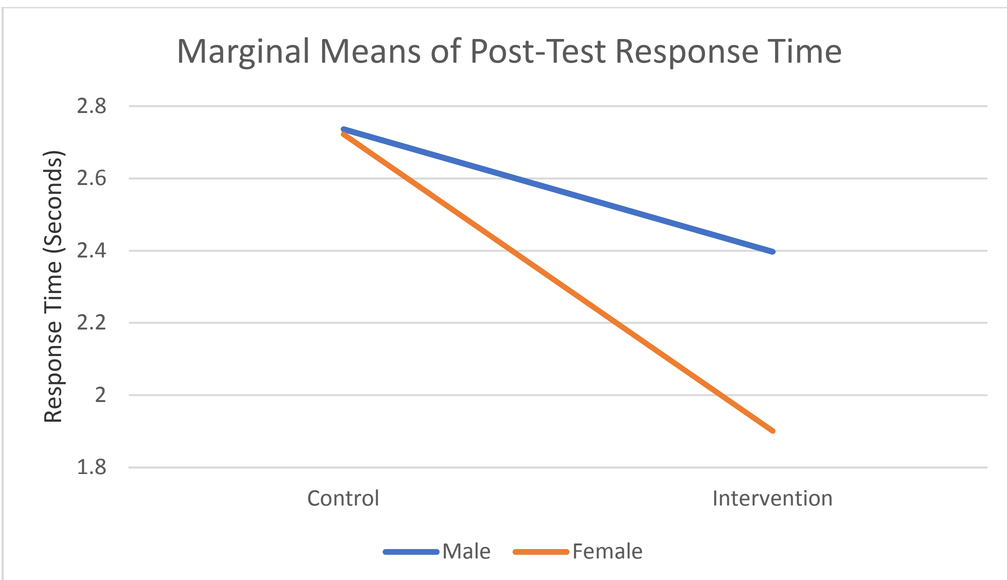

Figure 11. Mean response time of males and females in the intervention and control group when controlling for the pre-test scores.

Z-Scores

A repeated measure ANOVA was conducted with time as the within-subject factor and group as the between-subject factor where there was no significant interaction found. There was however, a significant time effect ($F= 7.00$, $p=0.1$, $\eta 2= .08$). This significant time effect in turn means that all children improved their Z-scores from pre-test to post-test (Figure 12). This means, out of the 16 trials in the day/night task, those responses that were right were also faster in the post-test from the pre-test. The same repeated measure ANOVA was conducted with gender as the between-subject factor in which there was no significant interaction or gender effect found there as well. Using the same analysis with age as the between-subject factor, there was still no significant interaction or age effect.

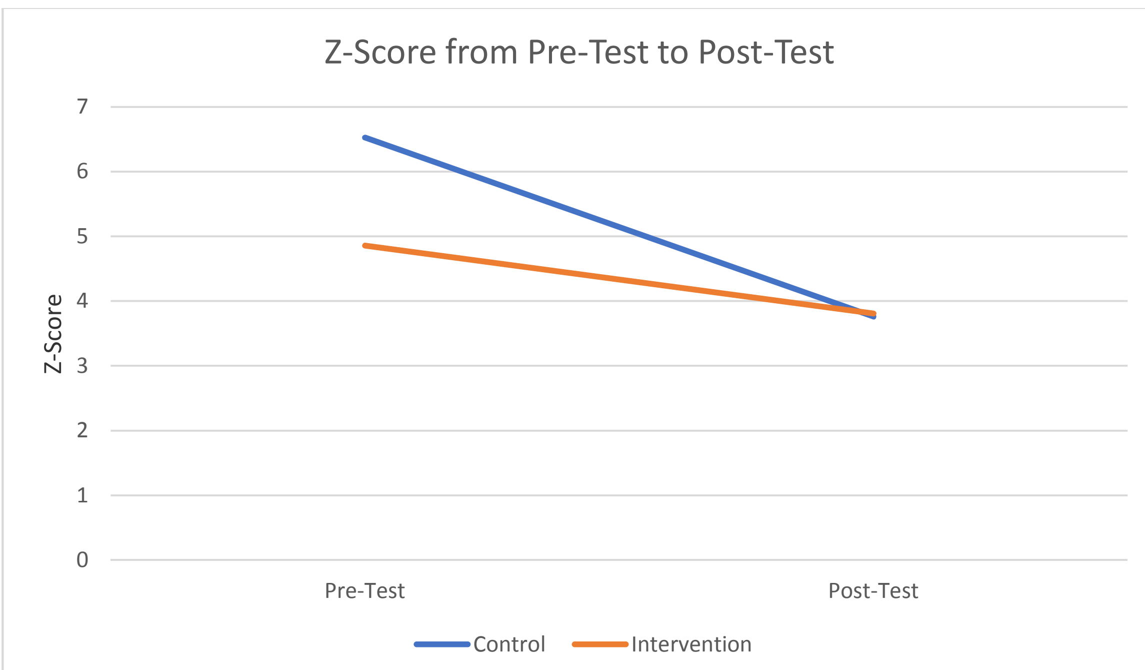

Figure 12. Z-score ([average RT of accurate trial answers * 16 total trials]/# of correct answers) from pre-test to post-test.

Table 5. Descriptive Statistics of Post-Test Response Time, Pre- and Post-Test Accuracy, and Pre- and Post-Test Z-Score Among Intervention and Control.

			Post-Test	**Pre-Test**
	Group	**N**	Mean(SD)	Mean(SD)
Response Time (sec)	Intervention	49		2.17 (0.81)
	Control	37		2.72 (1.04)
Accuracy	Intervention	52	11.08 (4.53)	11.96 (4.19)
	Control	51	10.39 (4.82)	11.92 (3.99)
Z-Score	Intervention	43	4.86 (3.48)	3.80 (6.04)
	Control	37	6.52 (6.41)	3.76 (2.55)

Level of Implementation with Teacher Logs

Teacher and Child Satisfaction

Based on the teacher log (APPENDIX 4) teachers rated on a 5-point scale their satisfaction with the Move For Thought PreK-K Program and what they believe to be the satisfaction rating of the children in their classroom. What was found is that the teachers were on average highly satisfied (Mean= 4.41, SD=.569) as well as their students (Mean=4.44, SD= .575), giving both the teachers and children satisfaction scores were on average, above a 4 point. Figure 13 shows the satisfaction scores for teachers and children, as well as the average from all four intervention classrooms.

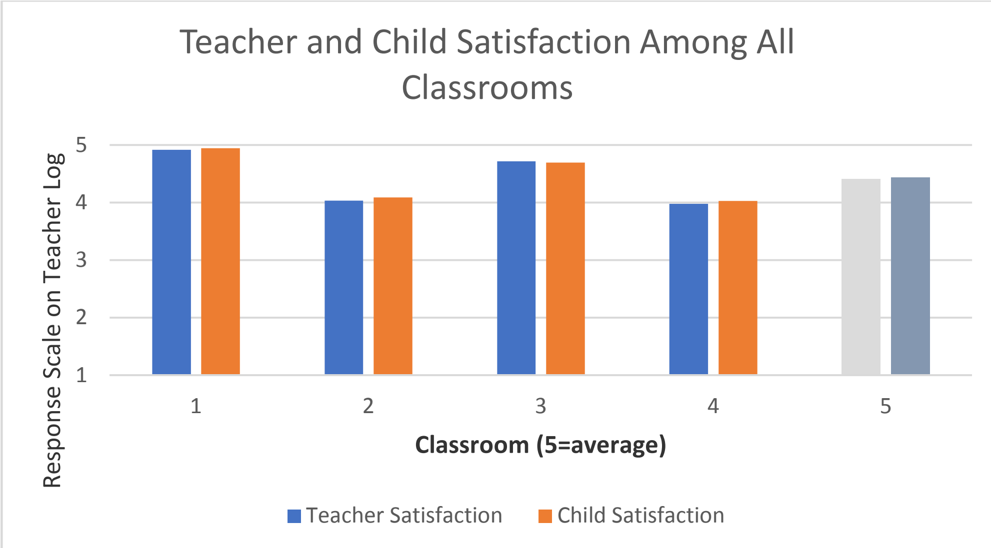

Figure 13. Teacher and Child Satisfaction Among Classrooms.

Average Number of Days the Move For Thought PreK-K Activities were implemented based on a percentage of the 8-week intervention.

On average, the Move For Thought PreK-K activities were implemented on more than 80% of days out of the 8-week intervention (Figure 14), with the most popular activity among the four classrooms being a transaction activity named "I say, you say".

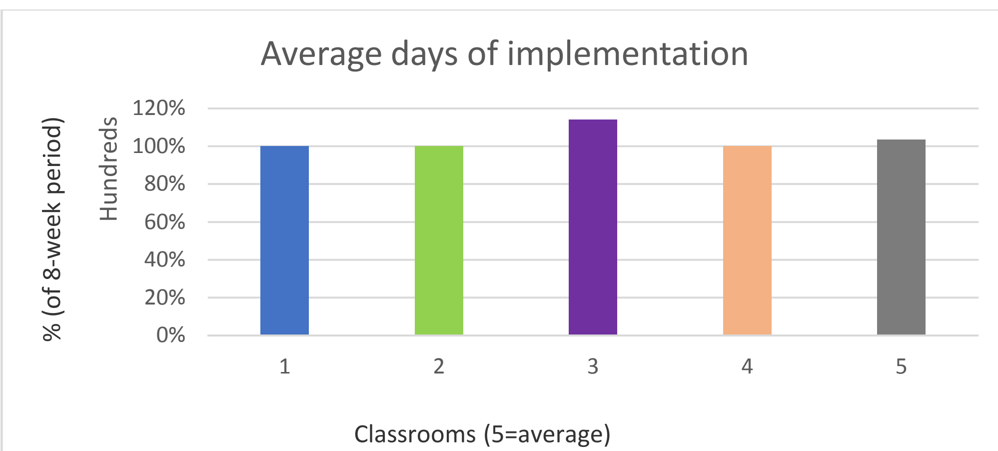

Figure 14. Average Number of Days Activities Were Implemented Among All Classrooms.

Average amount of time spent on the Move For Thought PreK-K Program Activities across the classrooms.

Of the early intervention classrooms, the time spent on each activity was roughly 10.5 minutes (Figure 15). The average minimum time spent on activities was 5 minutes and 25 minutes was the maximum. The average duration of the activities for teacher one was 9.58 minutes, 9.29 minutes for teacher two, 8.45 minutes for teacher three, and 9.17 minutes for teacher four. The average among all classrooms is shown in classroom five in Figure 15.

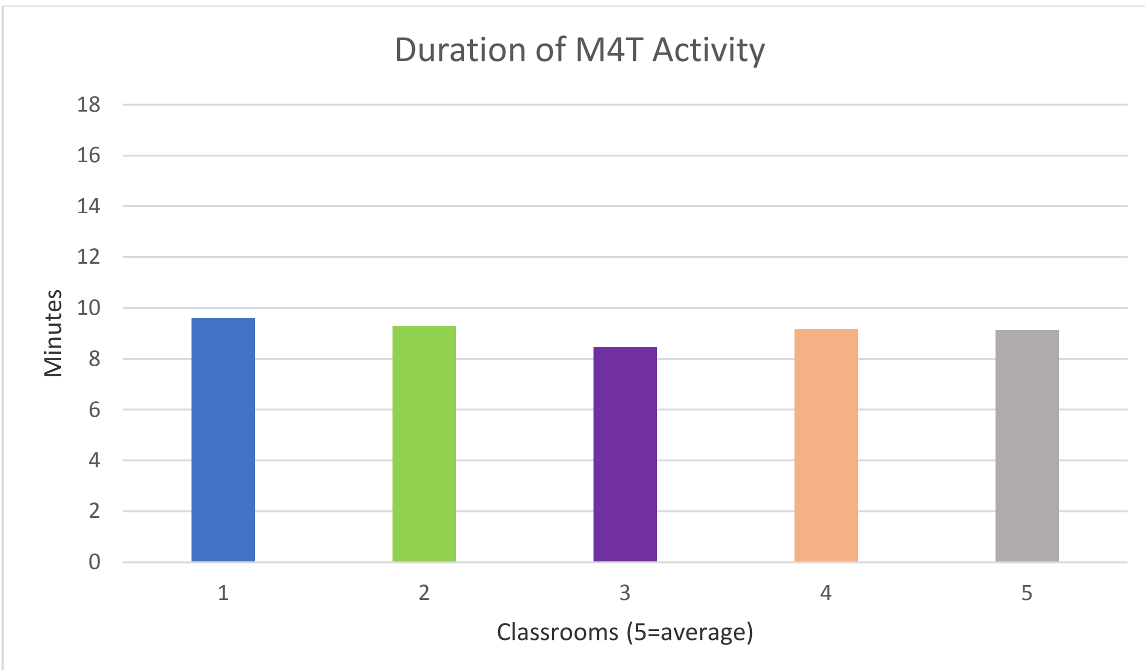

Figure 15. Average Duration of Activities Among All Classrooms.

Area of implementation of Move For Thought PreK-K activities

Out of the four early implementation intervention classrooms, the most used area for implementation was in the classroom (Figure 16). On average, the second most frequently used area was the common area in the schools, followed by outside implementation.

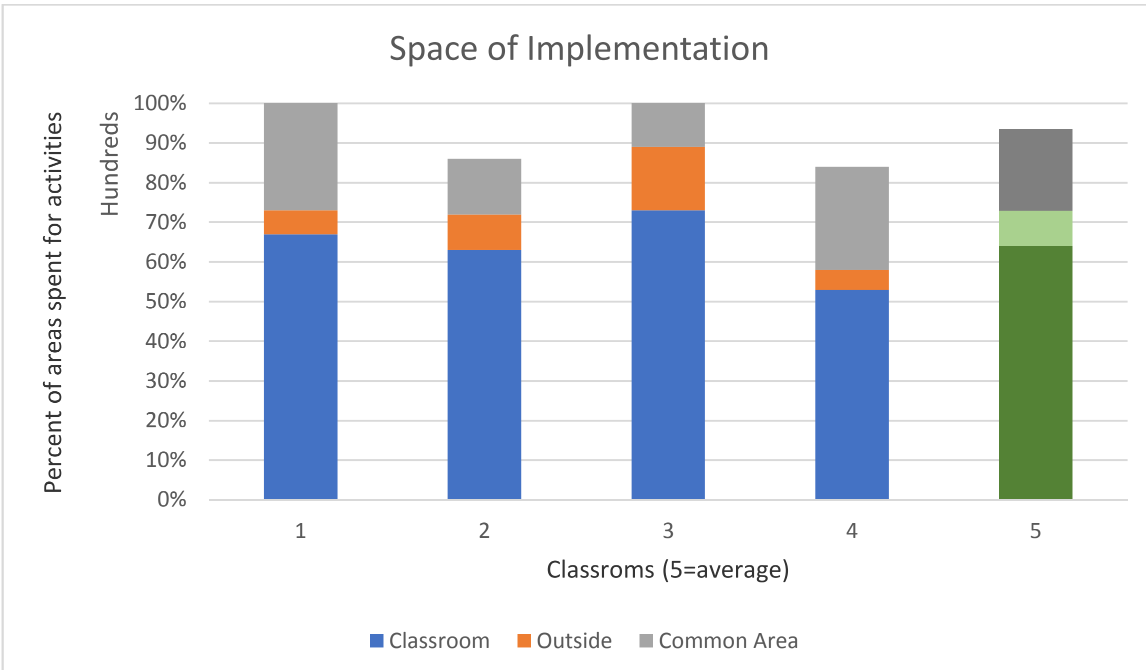

Figure 16. Space of Activity Implementation.

Student Engagement Levels During Move For Thought PreK-K Activities

As previously mentioned, not only is exercise shown to improve executive functioning skills, but for the exercise to improve executive functioning skills, it must be cognitively engaging as well. Teachers were asked to rate the level of engagement among their students, whether physical or cognitive. The levels of engagement seemed to be very similar in the fact that many teachers rated both the cognitive and physical engagement close to a score 3 (Figure 17). A score of 1 means the activity was "not at all", 2 means that the activity was "a little" cognitively or physically engaging, while a score of 3 means that the teachers believed the activity to be "very" cognitively or physically engaging.

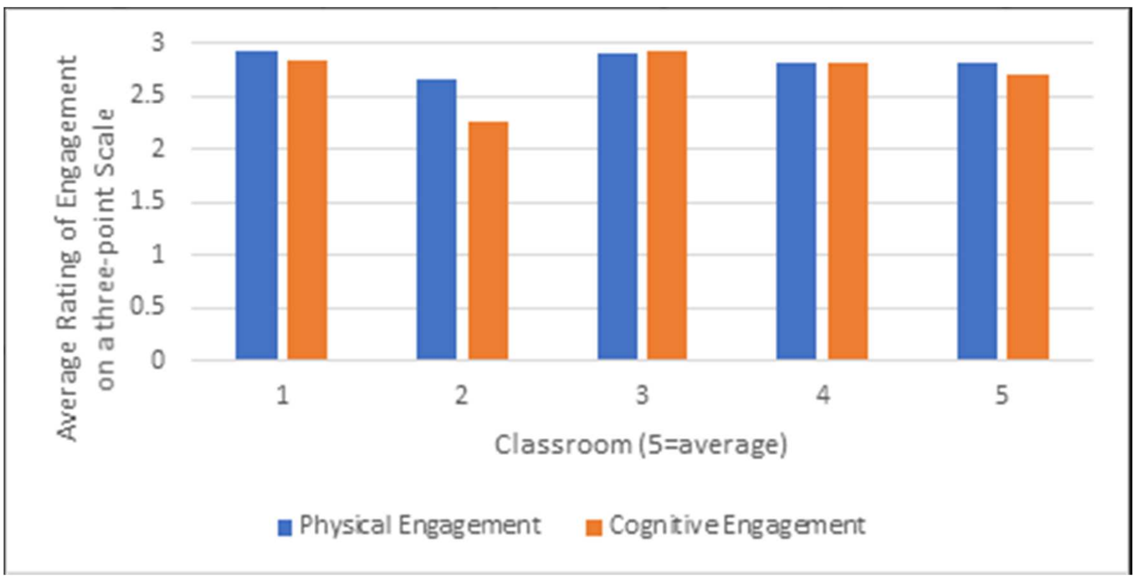

Figure 17. Average Engagement Among Each Classroom and on Average.

Incorporating Physical Activity to Utilize Social-Emotional Skills

The main executive functioning skill discussed in this thesis is the ability children have, to resist impulses and focus on one specific task even when there may be distractions nearby. Remembering from above, the ability to resist temptation and focus is the utilization of inhibitory control, or self-control. As shown by Figure 18, many of the activities are rated for having a high frequency of self-control being practiced. The next most common was the children's ability to regulate their emotions, followed by showing their ability of working with others (Figure 18).

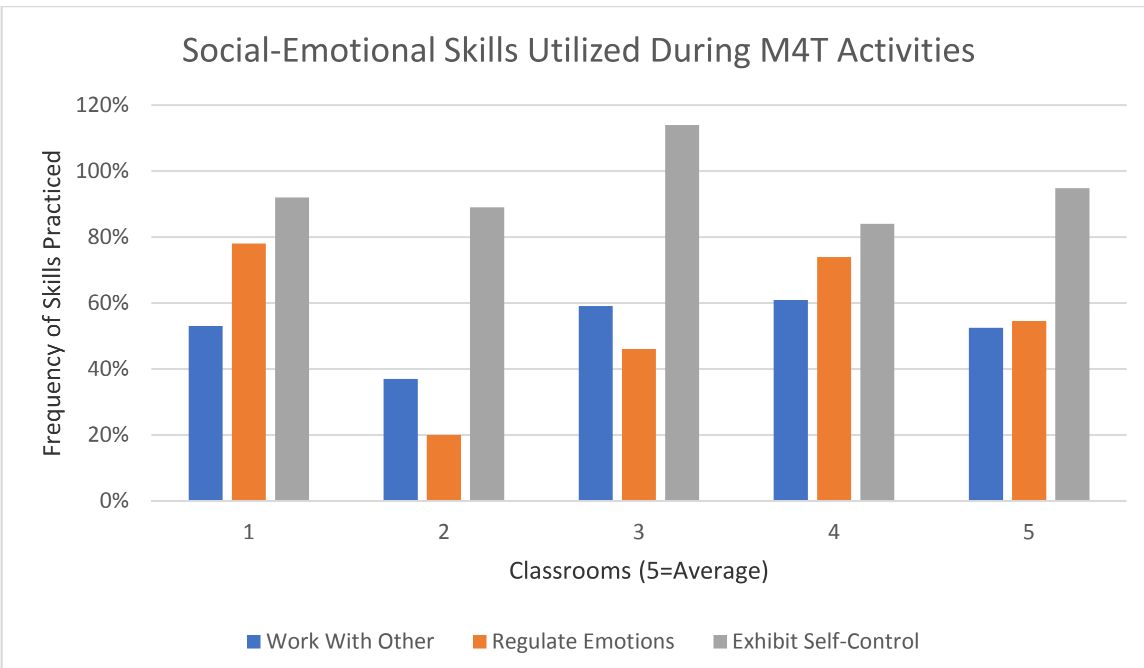

Figure 18. Average Social-Emotional Skills Used During Activities of All Classrooms.

Chapter 5. DISCUSSION

Roughly 50% of preschool aged children are not given the opportunity for daily outside play[62]. The 2008 physical activity guidelines recommend that children get at least 60 minutes of moderate physical activity per day[59]. It is crucial for children to participate in regular physical activity to facilitate the development of physical literacy and to build fundamental motor skills, along with strengthening executive functioning skills. It has been shown that classroom-based physical activity increases children's level of physical activity while also improving their classroom engagement[57,58].

After the implementation of the Move For Thought PreK-K program there was a significant improvement in response time for the intervention compared to the control. It is important to note that the average duration of activities implemented in the intervention group classrooms was roughly 10 minutes. This in turn means that even a short bout of cognitively engaging exercise has a positive impact on inhibitory control, an important executive functioning skill. This finding is supported by a narrative review and meta-analysis looking at the effects of a physical activity intervention on cognition in youth (Vazou, et al 2016), where an acute, short bout of exercise showed an improvement in children's executive functioning skills[34].

There was not a significant difference between boys and girls regardless of group. However, it was found that girls were significantly more accurate than boys on the day/night task. As for age, the younger children (< four years old) were less accurate than the older children (≥ four years old).

These results are consistent with the findings of Hillman and colleagues (2005) and Ellemberg and St. Louis-Deschnes (2010). It was found that after cycling for 40 minutes at a moderate intensity while watching an age-appropriate educational television show, all children improved their response time when completing a simple and choice reaction time task. Further research also found that fit children had faster response times than their unfit peers. When comparing age, adults still had a faster response time than all children, regardless of fitness level[60,63].

As for the level of implementation, the Move For Thought PreK-K activities are feasible, well-received by teachers and their students with an average rating of 4.4 out of 5 for both teachers and children, and physically and cognitively engaging. The activities are feasible in a way that they require little to no props and can be implemented in various areas such as the common area of schools, outside, and most frequently, in the classroom. As for activity engagement, teachers rated the activities a 2.7 out of 3 for cognitively engaging and a 2.8 out of 3 for physically engaging on the daily teacher logs.

The Move For Thought PreK-K activities require children to use and improve their social-emotional skills, most commonly their inhibitory control as recorded by the teachers in their daily logs. Children were also able to practice further skills by regulating their emotions and working with others. Future training could increase the prevalence of children practicing regulating their emotions and working with others to that of inhibitory control, as this was the most commonly recorded.

Overall, the Move For Thought PreK-K activities are effortless to implement as they can be performed in numerous areas and require little to no equipment, making it easier for teachers to execute. The activities are physically engaging and cognitively engaging, meaning that teachers can use this program to increase children's physical activity levels while continuing to work on their academic goals. The high satisfaction rating along with high engagement levels supports the idea that the children are motivated and having fun while learning.

Having fun while learning is important for creating a positive relationship with school, especially as these children are being prepared for a more intense curriculum in the future. From previous literature, the enthusiasm and attitudes of the teacher have a direct effect on whether the program is implemented or received in an appropriate manner[13]. As for time, the activities can be completed in as little as 10 minutes at a time to increase children's physical activity and to show positive improvements in executive functioning.

Limitations

Future research should examine the gender differences in the response time and accuracy after physical activity implementation and identify reasoning behind this. This is critical, as finding reasoning behind this could lead to the development of specific intervention and physical activity programs that are tailored to females and males. From this study, it showed that females were more accurate than males.

A limitation of this study is the short duration of eight weeks. This is a limitation in the fact that with a longer duration, the differences might have been stronger, and for accuracy, more time may be needed for changes to be evident. This time frame may not have allowed the teacher enough time to become comfortable when implementing the activities, as there was no teacher training. The absence of teacher training can affect the quality of implementation, as teachers most likely do the bare minimum without it. Another limitation was that the fidelity observation checklists were only completed on a sample of lessons. Future research should conduct the fidelity observations on each classroom that is implementing the Move For Thought PreK-K activities. Lastly, evaluation of the Move For Thought PreK-K program is needed with children in Kindergarten to test is feasibility and effectiveness in the different school structure.

Conclusion

From this study we can conclude that the Move For Thought PreK-K program activities were feasible and enjoyable for the teachers and children, while significantly improving the children's response times. It is important to note that the implementation does not require a large amount of time each day and did not negatively affect the children's classroom curriculum. There is a need for physical activity implementation in the classroom to combat the large amount of time spent in the sedentary position, as well as improve their academic readiness. The Move For Thought PreK-K program is an easy and effective tool to use to reach these goals in the preschool environment. More programs like this that integrate cognitively engaging physical activities in the classrooms are needed for children to facilitate holistic development and health, and to thrive at school.

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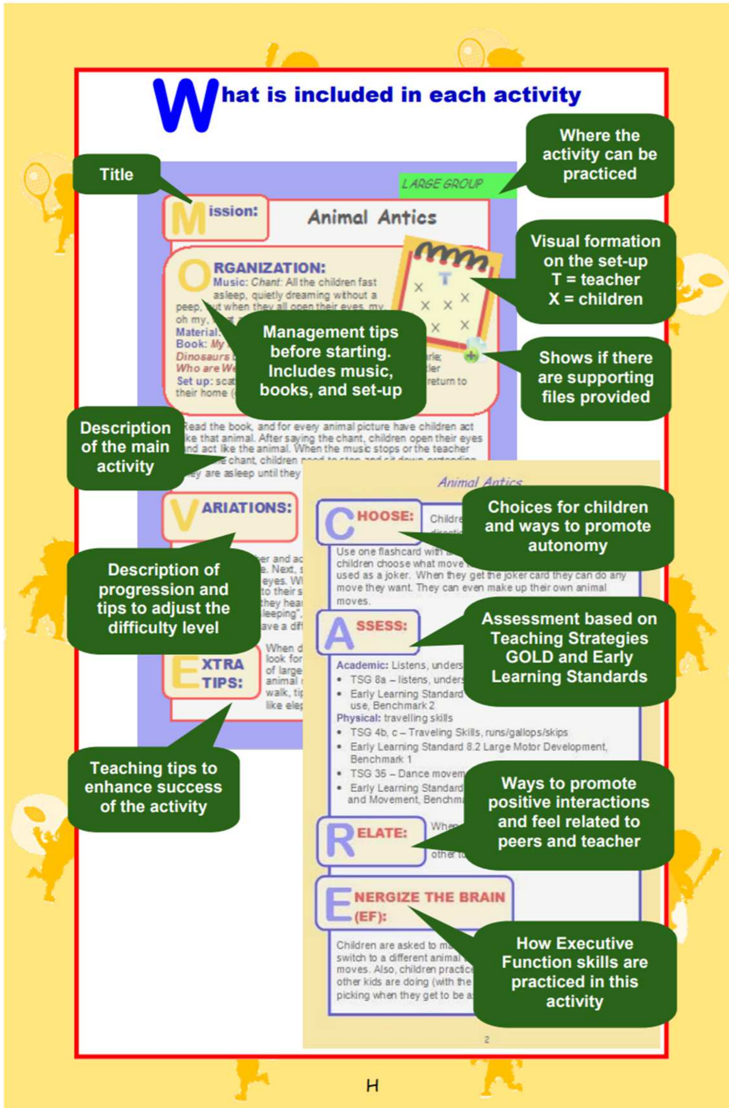
APPENDIX 1. WHAT ACTIVITIES INCLUDE



APPENDIX 2. TABLE OF ACTIVITIES

Table of Activities

Large Group

Small Group

Outside

Transition

* activities have supporting files

APPENDIX 3. TEACHER CHECKLIST

Teacher Checklist

Utilize the Move for Thought activities everyday (once a day) or more often if you'd like

a. Before you implement an activity:

a. Do I need any supporting files? (e.g., flashcards)
b. Do I need any equipment? (e.g., books)
c. Do I need music? (M4T or other)
d. Have I done the activity before?

If not, how can I keep it simple?
- *Read the main instruction for activity*
- *Read the extra tips*
- *Use music for starting/stopping and background, but not to pace the activity (let them move on their own tempo first)*
- *For some activities books are not required. Try first without the book and once students are familiar with what they need to do, add music and books*

If yes, how can I make it more challenging?
- *Check variations*
- *Check the "energize the brain" tips for more cognitive engagement*

b. As you implement an activity:

a. Is everyone safe? Do I need to move equipment?
- *Remind them to stay in their bubble and not let it pop!*

b. Is the activity cognitively engaging?
- *Change the rules, what they need to remember, and the moves,*
- *Ask them to think or share with you what they need to do before they move*

c. Is the activity physically engaging?
- *Provide a variation of movements (march, gallop, slide, hop etc.)*
- *Check the "start with the fundamentals" intro pages in the kit*
- *If they are standing for too long use a transition activity*

d. How are your students responding to the activities?
- *Make sure students are having fun while learning!*
- *Provide choices on how to move and where*
- *Ask them to work with the other kids and share what they are doing*

c. After you finish, respond to the questions in the daily teacher log.

Have fun!

Motor skills	Cues
Walk	walk tall like a giraffe, "choo-choo" train pump with arms (bent power arms)
March	swing arms, lift knees, head up, balanced stops
Run	head up, stay in your bubble, "choo-choo" train arms
Jump	jump on both feet, bend knees when landing, soft landing (like a kitty), swing arms
Gallop	face forward with leading leg, same foot forward
Slide	step sideways, shoulder faces where you go, don't cross legs
Leap	one foot up, push off with other leg, "part the curtain" with both arms, land on other foot
Hop	use arms ("hurray" arms), swing (nonsupport) leg, land lightly on same foot ("up & light")
Skip	step & hop on same foot, swing "choo-choo" train arms, pretend skipping on a hot surface (knee up)
Bear walk	walk with both hands and legs, keep legs straight
Crab walk	on hands and feet facing up, keep tummy up
Bunny jump	move weight from arms to legs, stay low
Frog jump	jump high, both hands and legs jump up
Overhand throw	make a big step with leg closest to target, make a T with arms (one arm points to the target and other arm points in opposite direction), make an L with throwing hand and stretch arm way back, release
Catch	spread fingers (thumbs up; pinkies down for catches below waist), reach out (extend arms), eyes on the ball, hug the ball
Kick	arms in opposition to legs, swing kicking leg forward, eyes on ball, head down
Dribble	spider fingers (use soft parts of fingers), bend knees, hand on top of ball, flexible wrists
Balance	squeeze muscles, open arms, head up, hold it still

APPENDIX 4. TEACHER LOG

TEACHER'S NAME: ____________________ CLASS: ________ SCHOOL: __________________ WEEK: _______ TO_______

WEEK # 1	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Which M4T activity did you use today?	Name:	Name:	Name:	Name:	Name:
How many children participated?					
Where did you practice?	☐ classroom ☐ outside ☐ common area/ hall	☐ classroom ☐ outside ☐ common area/ hall	☐ classroom ☐ outside ☐ common area/ hall	☐ classroom ☐ outside ☐ common area/ hall	☐ classroom ☐ outside ☐ common area/ hall
What was the duration of the activity?	☐ 5min ☐ 10min ☐ 15min ☐ 20min ☐ 25min ☐ 30min	☐ 5min ☐ 10min ☐ 15min ☐ 20min ☐ 25min ☐ 30min	☐ 5min ☐ 10min ☐ 15min ☐ 20min ☐ 25min ☐ 30min	☐ 5min ☐ 10min ☐ 15min ☐ 20min ☐ 25min ☐ 30min	☐ 5min ☐ 10min ☐ 15min ☐ 20min ☐ 25min ☐ 30min
Did you use any of the supporting files?	☐NO ☐YES	☐NO ☐YES	☐NO ☐YES	☐NO ☐YES	☐NO ☐YES
Did you use music?	☐Move for Thought CD ☐Other CD/music ☐No music	☐Move for Thought CD ☐Other CD/music ☐No music	☐Move for Thought CD ☐Other CD/music ☐No music	☐Move for Thought CD ☐Other CD/music ☐No music	☐Move for Thought CD ☐Other CD/music ☐No music
How satisfied are you with the M4T activity?	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied
How physically engaged were the students during the M4T activity?	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very
How cognitively engaged were the students during the M4T activity?	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very	☐ 1- not at all ☐ 2- a little ☐ 3- very
How satisfied were the children with the M4T activity?	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied	☐1-very unsatisfied ☐2-unsatisfied ☐3-neutral ☐4-satisfied ☐ 5-very satisfied
While practicing the activity, did the children: (check all that apply):	☐work with others ☐regulate emotions ☐ show self-control	☐work with others ☐regulate emotions ☐ show self-control	☐work with others ☐regulate emotions ☐ show self-control	☐work with others ☐regulate emotions ☐ show self-control	☐work with others ☐regulate emotions ☐ show self-control
Did you face any challenges? If yes, please describe:					

APPENDIX 5. FIDELITY CHECKLIST

Evaluation of the Move for Thought PreK program – Fall 2016 Fidelity Checklist

Date: ____________________ Teacher Name: _____________ School: _____________
Name of activity: ______________________ Area: Classroom ☐ Outside ☐ Hallway ☐

Fidelity Assessor: _________________________________

Complete the checklist for each item. If the teacher completed the item as defined, then mark "Yes" but if the teacher did not meet the criteria mark "No." You are looking only at the teacher's behavior for the first 7 questions and not the children's responses (e.g., if a teacher encourages children to jump but several children do not respond, you would still mark it as a "Yes", if there is a waiting line, mark the time one child practices).

Time activity started: ___________ Time activity ended: ______________
Number of children participating: ____ Children not participating: ___ why? __________________

Skills to be addressed at every lesson:

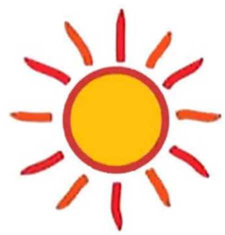
1. Encourages complex movement at least 1 time per lesson.	Yes 1-3☐ >4 ☐	No
2. Encourages children to be cognitively engaged in the activities at least 1 time per lesson.	Yes 1-3☐ >4 ☐	No
3. Includes opportunities for children to show self-control at least 1 time per lesson.	Yes 1-3☐ >4 ☐	No
4. Includes opportunities for social and emotional engagement in the activities at least 1 time per lesson.	Yes 1-3☐ >4 ☐	No
5. Provides choices and sense of autonomy	Yes 1-3☐ >4 ☐	No
6. Allows enough time for repetition and practice (at least 30 sec a move, or 3-5 attempts).	Yes	No
7. Are children focused and engaged?	No A little	A lot
8. Skills that were practiced:		

Level of activity for majority of children *(circle and write duration for each level of PA)*					Minutes
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	
Sits	stands	only upper body	walk	very active *(run, jump, bear walk)*	

APPENDIX 6. DAY/NIGHT DESCRIPTION

DAY/NIGHT

"When you see this picture of a sun, I want you to say NIGHT. Can I hear you say Night?"



"When you see this picture of a moon, I want you to say DAY. Can I hear you say Day?"

REMEMBER

- Unplug headphones
- Plug in microphone and place it near the monitor
- Make sure volume is on so that you can record the BEEP when the pictures come up
- Turn on audacity and test to see if it is working. Also crank the microphone volume up using the bar on the upper right-hand side of Audacity (there's a picture of a microphone).
- Get coding sheet ready – you will code up to three responses for each trial: the FIRST response and then up to two Self-Corrections. **NOTE**: A child saying DayNightDayNightDayNight is NOT a self-correction – simply count "Day" as the first response in this case.

Audacity (See **Audacity Instructions** for detailed information):

- Open Audacity
- To start recording, click on the red circle (record button).

DAY/NIGHT

- Make sure the volume of the microphone is on max.
- Test to make sure it is recording sound by talking into the mic – the red bar above the picture of a microphone should light up and spikes should be visible on the recording track.
- Leave the recording screen on the desktop and run presentation.
- After the game is finished save the audio file:
  - Go to File
  - Then click on "Export as WAV"
  - Type in the subject ID
  - Save files in your Audio_DayNight folder

THE GAME:

- Press "d" for day answers and "n" for night answers.
- Press "0" if you get another answer (e.g., sun, moon, etc) or no answer.

1. ***Demonstration:***
   The rules are explained: "When you see this picture of a sun, I want you to say 'Night", etc.

2. ***Practice***:
   There are 2 practice trials in a block (one sun and one moon). If a child misses the first trial, the computer will automatically repeat the rule for that trial. If a child misses either trial, after the second trial, the program will repeat BOTH rules, beginning with the rule they missed.
   If kid doesn't answer, don't wait too long to go to the next trial because it is embarrassing for the child to have you wait there for the answer when he/she doesn't know it. So rather than potentially embarrass the child, just wait 2-3 seconds and then help the child out.

   If the child misses either trial in practice, they will receive another practice block (up to 3 practice sessions total). Make sure that when you repeat the rules, you emphasize that even though it may be VERY SILLY, they should say NIGHT to a picture of a Sun and DAY to a picture of a Moon.

3. ***Testing:***:
   16 trials. If the child misses either of the first two trials and has NOT received all three practice sessions, the first two trials will be discarded and practice will be repeated (up to a TOTAL of 3 sessions)

   No feedback should be given during the actual game. If the child does not answer, gently prompt them with "What do you say?"

APPENDIX 7. IRB APPROVAL FORM

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 10/12/2016

To: Dr. Spyridoula Vazou
235 Forker Bldg

From: Office for Responsible Research

Title: Integrating Physical Activity with Academics: Evaluation of efficacy and effectiveness

IRB ID: 15-579

Study Review Date: 10/10/2016

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (1) Research conducted in established or commonly accepted education settings involving normal education practices, such as:
  - Research on regular and special education instructional strategies; or
  - Research on the effectiveness of, or the comparison among, instructional techniques, curricula, or classroom management methods.

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**

- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

  Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

  Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption**, even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.