Effect of Sensory Stimulation in Physical Activity on Academic Achievement and Classroom Behavior in Elementary Students

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Effect of Sensory Stimulation in Physical Activity on Academic Achievement and Classroom Behavior in Elementary Students

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Kinesiology

by

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ABSTRACT

Technological advancements and increased screen time has increased sedentary activity and altered the brain development of children. With the reduction of PE and recess in schools, increasing sensory stimulating physical activity can be pivotal in cognitive and behavioral development. Activities such as rolling and spinning enhance the sensory system in organizing and filtering information efficiently for quicker and more appropriate responses to stimuli. This study investigated the effect sensory stimulation had on auditory memory, reading levels and behaviors of elementary students.

During a 6-week period, 176 students, grades 1-5, participated in the sensory maze Minds in Motion, 15 sensory activities (adapted with permission from Minds in Motion), focusing on processing and integration motor skills. Each grade included an intervention group (52 male; 39 female) participating in 20 minutes of the Minds in Motion maze (10 minutes in the morning and afternoon) and a control group (49 male; 45 female), continuing with normal school activities. Pre and post difference scores of the dependent variables (Auditory Memory Test, Developmental Reading Assessment, and Office Referrals) were calculated.

Results of the MANOVA found a significant multivariate F, Wilks’s Λ = .95, F = (3,170) = 2.95, p = .034. Results of the univariate test found significance for Auditory Memory (p = .029), with the intervention (M = 3.51) scoring higher than the control (M = 1.87). Reading level mean differences of the groups did not differ. Classroom behavior did not produce a significant effect.

Data suggests the Minds in Motion maze benefits the auditory memory of children. Although reading levels reported non-significance, mean change illustrated improvements. Longer maze time beyond the 6 weeks could induce improvement. Qualitative remarks from
participating teachers indicated the maze was a positive addition to the school day, especially with classroom management, the variable found to have no positive significance in the study. If the study was longer, involved a larger sample size, more homogeneous sample, or used alternative reading and behavior assessments, the results might be stronger. Further research is warranted. This pilot study suggests the maze can have a positive effect on auditory memory, reading levels, and classroom behavior.

*Keywords*: sensory/motor development, balance, vestibular system (balance/inner ear system), sensory integration, classroom behavior, reading levels, auditory memory, elementary students
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DEDICATION

To my parents, Harold and Lena Mitts who taught me the value of a strong work ethic. Their everyday example created the inner spirit of who I am today. Unable to earn college degrees themselves, their belief in, and support of, education in the lives of their children was always a top priority. Always reminding me that I could accomplish whatever I set my mind to and my degrees were something nobody could ever take away from me. Thank you for believing in me during the moments I had a hard time believing in myself. My sincere thanks and appreciative love to two amazing people I am blessed to call my parents.
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CHAPTER 1

INTRODUCTION

The sensory system is responsible for detecting stimuli from the external environment. Once detected, the body responds through the interpretation of such stimuli. This occurs when information about sensations is passed back and forth between the central nervous system (CNS) and nerves in the brain and spinal cord, and the peripheral nervous system with the nerves that are outside the CNS (Kranowitz, 2004). Research suggests that stimulation of the sensory system can have a positive effect on the cognitive, emotional and social well-being of a child. Furthermore, by specifically challenging the senses of touch, hearing, vision, and balance not only is there evidence of enhanced learning, but also improvement in children’s behavior.

The initiation, frequency, and duration of sensory stimulation in the early stages of a child’s development can be pivotal. Today, with the decreasing amount of physical education, recess and free play and the increase in technological screen time, the visual, auditory, and vestibular processing systems of children are suffering. According to research, these three systems have a direct impact on all aspects of a child’s learning in the classroom and rely heavily on each other for maximum functioning. Likewise, each plays a key role in supporting the behavioral and emotional aspects of learning as well, which is why some children with poor motor skills also may struggle with emotional control. In Astronaut Training: A Sound Activated Vestibular-Visual Protocol, Mary J. Kowar says, “All parts of the Vestibular-Auditory-Visual Triad are needed and their successful integration will impact all aspects of behavior from planning, directing, and controlling our actions to achieving high level academic performance” (2005).
Following is a brief discussion of this relational triad: the visual processing system, auditory processing system, and the vestibular system. The visual processing system integrates all sensory and motor processing information including the ability to track words on a page while reading. If the vestibular system of a child is undeveloped, the cranial postural muscles weakened and the balance of the head skewed. Due to this weakness, a letter may jump off or move about the page, making reading difficult. On the other hand, the auditory processing system processes vibrations in the environment. Postural muscles in this system enable children to process sounds used for speech, language, communication, and expression more efficiently. These muscles also contribute to eye muscle control and visual perception.

The vestibular system is the sensory system specifically involved in the development of the middle and inner ear and recognized mostly for its critical role with balance, equilibrium and motor development. When we move our heads, the fluid in these organs moves and shifts, constantly providing us with information about the position of our heads and bodies in space, known as spatial awareness (Braley, 2014). However, this system, which is the base to the other two, holds another important responsibility as it combines with the other senses (namely the eyes and ears) in filtering through environmental stimuli and providing responses. Movements such as jumping, swinging, rolling, crawling, and climbing are responsible for developing the vestibular system, thus aiding in the more appropriate analyzation and response of sensory information.

Rolling, climbing, jumping, crawling, and spinning are basic motor skills which feed into stimulating the sensory system, encouraging development in both sides of the brain, and serve as the foundation for growth and learning. Without this sensory stimulation, a child cannot develop
their auditory or visual systems fully. When a child uses both sides of the brain and does so with good integration and timing, smooth and coordinated movements occur. However, when both sides of the brain do not integrate on a regular basis, non-fluid movements occur due to poor brain processing. This non-fluid movement is indicative of poor brain processing that can manifest itself in learning problems, in learning disabilities, poor academic performance, and many other struggles in life (Belgau, 2000).

On the other hand, when a child has a well-developed sensory system, information from the eyes, ears, balance, and movement organize more efficiently and filter in the brain quicker, allowing the brain to provide appropriate responses to environmental stimuli. To accomplish this, much research suggests activities that promote brain integration be performed frequently until movements are fluid and coordinated and the eyes are converging efficiently. Likewise, a growing body of mainstream scientific research clearly points to the critical role that sensory/motor neural development through the vestibular system (balance/inner ear system) plays in the learning process (MIM, 2012).

Research also suggests that sensory stimulation exercises can quickly enrich visual-perceptual problems in children with vestibular dysfunction. In fact, children respond more quickly than adults because of their greater neural plasticity – the ability to more quickly compensate for and adapt to vestibular deficits (Cronin, 2004). With an individualized approach, exercises addressing eye-movement control, balance, and body movement functions could have an immediate and dramatic positive effect on the academic achievement and classroom behavior of elementary children. In schools, teachers and occupational and physical therapists are excellent professionals to integrate the vestibular training into activities for learning, movements, and behavior (Cronin, 2004).
Minds in Motion

The Minds in Motion Maze (MIMM), a system consisting of fifteen (15) different daily activities configured into stations, will provide the motor development exercises for students to experience increased sensory processing and increased sensory integration during the study. Minds-in-Motion is an advanced development program with the goal of improving children’s visual and auditory processing, and motor skills (MIM, 2012). The 15 daily Minds-in-Motion activities have been designed to develop and challenge a student’s balance and learning capabilities (MIM, 2012). It is for the use of classroom or physical education teachers, inside or outside environment, in limited space, and with affordable equipment. In the case of this study, the MIM Maze is located in a hallway connecting the main school building and the gymnasium and monitored by classroom teachers. The movement activities involved in the maze are skill-related fitness components such as balance, coordination (eye−hand, eye−foot, and bilateral limbs), and power. The Maze approach also includes health-related fitness components such as muscular strength and endurance, flexibility, and cardiovascular endurance (MIM, 2012).

The MIMM premise, including the Maze approach, is that there is a link between early afferent neural stimulation and cognitive abilities (Meyer, 2012). Specifically, movement activities that stimulate the vestibular system such as balancing, rolling, pushing, pulling, stomping, jumping, to name a few, have an impact on children’s academic, social, behavioral, and physical domains (Meyer, 2012). The Maze Handbook (Meyer, 2012) provides step-by-step information to create an obstacle course that can be adjusted to a small or large space and to a daily school schedule. The Maze has been implemented in several preschools, elementary schools, and student centers in 12 different states (MIM Website). To date, MIM has generated hundreds of data points collected during children’s clinical experiences in its facilities.
Minds in Motion is a “unique blend of gymnastics, balance exercises and applied technology, all focused on strengthening the brain’s ability to process and organize information efficiently” (Pandolfo, 2012). Candace Meyer, the founder of Minds-in-Motion developed a program, which is now called the “MAZE,” blending developmental gymnastics, balance exercises, and complex movements through a rotating set of protocols. These activities, sometimes referred to as “yoga for the brain,” ranges from full-body exercises to isolated eye movements (MIM, 2012). The comparative, clinical data of Meyer’s program shows that when students, of any age or race or socio-economic level, have opportunities to build strong neurological foundations by activating sensory-motor integration processes, they become positioned to learn with ease and success, and are able to reach a higher potential (MIM, 2012).

Background

Modern conveniences, technology, and safety measures have vastly altered the development of the human brain (Hannaford, 1995; Jensen, 1998). The technological advancements of the era and the increased screen time of electronic devices (IPhones, IPads, laptops, and TV’s) by toddlers and young children have increased sedentary time. Couple that with the reduction in both structured (physical education) and unstructured (recess) physical activity levels in elementary schools and the importance of vestibular stimulation becomes quite evident. Lastly, the business industry has played a pivotal role in the entitlement phenomenon. As these toddlers become children, manufacturers have created “easier” modalities that provide less opportunities for them to develop fine motor skills like writing (keyboarding), tying shoes (Velcro), and buttoning a shirt (pull overs and zippers).
According to Candace Meyer (2005) many babies no longer have true birthdays, but rather they are born when a doctor’s schedule allow, not when they are ready. Lack of movement as babies and toddlers can ultimately lead to learning problems and behavioral issues in elementary school. Whether it be spending time on their stomachs, crawling, or bouncing like a pony on a parent’s knee, children are spending less time moving and more time sitting in car seats and high chairs. Recommendations given to parents to avoid laying their babies on their stomachs may be preventing these little ones from strengthening their neck muscles, developing core muscles, and starting brain development. The crawling process can aid in the development of vestibular reflexes as well. As more and more parents focus on rushing the process of crawling so that their child can walk earlier in the developmental process, babies are spending less and less time on their stomachs, negatively affecting the development of the sensory system. Cuddling and rocking an infant sends impulses directly to the cerebellum stimulating development (Restak, 1980).

Next, the decline in youth physical activity is another reason for sensory stimulation. Whether it be in an organized setting such as physical education class, at an unstructured school recess, or outside the school domain, children are moving less and sitting more. Few children in the United States, probably no more than half, meet the currently recommended standard of at least 60 minutes of vigorous-or moderate-intensity physical activity daily (CDC, 2012). Thus, with the number of recesses and physical education classes continuing to decline during the typical school day, it is worth researching how moving the body in as many different ways as possible effects children academically and socially. This decline has also reduced the opportunities for children to develop their sensory systems through a wide range of movement activities. For their brains to function optimally and to do their best academically, children
generally need regular activity periods, in addition to physical education class and recess (Reilly, Buskist & Gross, 2012).

Remarkably, over the past 50 years, opportunities for children to play freely have declined continuously and dramatically in the United States and other developed nations; and that decline continues, with serious negative consequences for children’s physical, mental, and social development (Gray, 2001). Typically, children from toddlers on through adolescents, provided themselves with an abundance of vestibular stimulation – jumping, swinging, turning somersaults, walking on top of the garden wall, riding skateboards, – mastering all varieties of movement through space. Today, many schools have removed swings and other playground equipment. So, because of fear that a child might be injured, children are affected by lack of needed movement opportunities (Moore, 2017). The overarching question wonders how this shift in “play” has affected children’s vestibular systems and in turn, the way they perform academically and behave socially.

Also, an increase in technological development and children are simply more sedentary than ever before. Before the world of computers, IPHones, and electronic games, children were more likely to engage in vestibular development as they played on a Teeter Totter, hung upside down on monkey bars, jumped off high-arching swings, or spun on a merry-go-round in the local park. A child is six times more likely to play a video game on a typical day than to ride a bike, according to surveys by the Kaiser Family Foundation. In addition to the advancement and convenience of technology, liability concerns now prohibit the use of these sensory activities in most venues. Nowadays, this sort of playground equipment, considered hazardous for children is a potential lawsuit waiting to happen in school districts throughout the United States. "You can't even buy a teeter-totter anymore because of the back injuries they can cause," said Tim Gilbert
of Moore-Iacofano-Goltsman, a Berkeley design firm that regularly works on redesigning playgrounds. “Metal pipe monkey bars are gone, and the only merry-go-rounds you can buy have governors to keep them from going too fast” (Wildermuth, 1997).

Another reason to include sensory stimulation for elementary students is to address behavior issues, namely ADHD, in the schools. Last year, there were 10.4 million children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD), up 66 percent since 2000 (Pandolfo, 2012). By stimulating the vestibular system, visual and auditory processing improve, which in turn can improve a child’s ability to focus in the classroom. Increased focus can account for improvement in a child’s educational process whether it be taking verbal instructions from a teacher or using mental rehearsal in recalling spelling words written on a white board. Vestibular Input “coordinates movements of the eyes, head and body” which affects our body’s balance, muscle tone, visual-spatial perception, auditory-language perception and emotional security (Kranowitz, 1998). A study by Arky (2010) found that one in every six children has sensory issues that make it hard to learn and function in school. While sensory processing issues are often seen in autistic children, they can also be found in those with ADHD, OCD, and other developmental delays, or with no diagnosis at all. Scientists have observed that children and teenagers with hearing and balancing disorders often have behavioral problems. Activities that require an individual to move both sides of the body synchronously are dependent upon the timing resolution in the brain. By doing these movements, studies have shown increasing brain timing and reaction time benefit learning disorders such as ADD/ADHD.

The study of eye movements during reading has a long and rich history dating back to the latter part of the 19th century (Rayner, 2009). Most reading problems are caused by inefficient coordination and integration between the many brain systems involved in the reading
process and can be dealt with through sensory integration and balance therapy (Belagu, 2000). For example, the gaze and fixation problems associated with vestibular dysfunction can lead to reading problems requiring specific therapy (Braswell and Rine, 2016). Another cause related to reading problems, eye convergence insufficiencies provides reasoning behind the necessity of sensory stimulation. The eyes converge when a person focuses on near objects like reading a book, tying a shoe, or sending a text message. Convergence insufficiency limits a person’s ability to work with visual information at close distances (Cavazos, 2017) including missing words, losing their place, skipping lines, or misreading lines completely.

Often, but not always, what is perceived as a memory problem is really a problem with attention (Bilgrei, 2014). A poorly developed sensory system can interfere with the process of taking in information and being able to retrieve it and prepare the correct response. Additional research on memory and sensory stimulation focuses on how the development of both sides of the brain assist in attending to stimuli for longer periods of time and the increase in reaction time involved in processing information that is absorbed by hearing.

Today’s children do not get the early motor stimulation needed for basic, much less optimal, school success (Jensen, 1998). However, little is known about the impact of vestibular loss on cognitive development in children (Weiner-Vacher, Hamilton, & Wiener, 2013). Research gives strong evidence that daily physical movements integrated into the curriculum increases academic scores (Hannaford, 1995; Michaud and Wild, 1991; Martens, 1982). In terms of academia, the sensory system plays an imperative role. The vestibular system provides input for motor control of the eyes (this is called the vestibule-ocular reflex), which is important for learning to read and write, keeping pace with schoolwork, and developing fine and gross
motor control (Cronin, 2004). Today’s children do not get the early motor stimulation needed for basic, much less optimal school success (Jensen, 1998).

Research has shown that motor skill and development is important to learning and thus, improving the education of children. In schools, teachers and occupational and physical therapists are excellent professionals to integrate the vestibular training into activities for learning, movements, and behavior (Cronin, 2004). Teachers must be aware that sensory motor integration is fundamental to school readiness (Ayers, 1972; Huston, 1982; Hannaford, 1995). Thus, establishing a mandatory, planned and specific motor stimulation program for elementary students, such as the Minds in Motion (MIM) and studying the effects of the maze on memory, reading levels and behavior is worth researching.

**Purpose of the Study**

The purpose of this quantitative study seeks to investigate to what effect sensory stimulation in physical activity has on auditory memory, reading levels and classroom behavior on first through fifth grade students in an elementary school located in Joplin, Missouri.

**Research Hypothesis**

The researcher’s hypothesis is that by having elementary school teachers engage elementary students into a daily process of developing the sensory system through physical activity, academic performance and classroom behavior will improve in these students as opposed to those students whose teachers do not expose them to the sensory exercises. Students who are physically active tend to have better grades, school attendance, cognitive performance (e.g. memory) and classroom behaviors (e.g. on-task behavior) (CDC Website). This quantitative study seeks to answer the following questions in regards to the effects of vestibular
stimulation on first through fifth grade students based on the difference between pretest and posttest scores of an Auditory Digit Span Assessment, Developmental Reading Assessment (DRA), and number of office referrals (visits to the principal’s office). This study will use a pretest/posttest design to investigate:

(1) to what extent does the Minds-in-Motion intervention maze affect the auditory memory of elementary students as measured by the Auditory Digital Span assessment?

(2) to what extent does the Minds-in-Motion intervention maze affect the composite reading levels of elementary students as measured by the Developmental Reading Assessment (DRA)?

(3) to what extent does the Minds-in-Motion intervention maze affect the classroom behavior of elementary students as measured by number of office referrals

Assumptions, Delimitations, and Limitations

Assumptions. The researcher will address the following assumptions made during the study. It is assumed that:

(1) all the students will understand how to perform all fifteen maze activities, perform the activities correctly, and give their best effort when doing so.

(2) the research team members ensure that the students understand the auditory memory assessment and conduct it following the precise directions given to them at the onset.

(3) the classroom teacher(s) adequately administer the DRA reading test, closely oversee the maze activities for proper form, and instill common behavioral classroom
expectations in their classrooms. In doing so, pretest and posttest results will show consistency.

(4) all participants will participate in the minimum number of maze sessions during the intervention period of this study and will not be absent during pretesting and post testing.

(5) students will follow the rules, as directed, throughout the intervention maze and will fully participate during the entire ten-minutes of each maze session to increase the internal reliability and validity of the results.

**Delimitations.** The researcher will address the following delimitations pertaining to the study. They are as follows:

(1) the participants are from a small elementary school in Joplin, Missouri, so the findings for this study cannot be generalized for other populations.

(2) the grades used in the study include participants from grades 1-5 only, thus eliminating those students younger and older than the previously mentioned sample population.

(3) the activities of the control group will be varied by the determination of the classroom teacher including reading time, math curriculum, specials (art and music), spelling, and traditional classroom protocol.

(4) although the participating teachers received instruction on Minds in Motion protocol, only one teacher has attended a Minds-in-Motion center for proper training.

**Limitations.** The researcher has identified a few limitations for this study.
(1) Pretest posttest designs require participants to perform at their “best” during the testing periods possibly creating a negative impact on the results when a participant performs when not feeling well, is unmotivated, or has an underperforming day.

(2) The Developmental Reading Assessment (DRA) is a limited assessment for reading scores because there is not a standardized measurement for all grade levels.

(3) Administering the study during a typical school day, the environment in which the pretest and posttest is administered could change out of necessity thus possibly skewing the results.

(4) Conducting the study in a school with students that historically rate low in reading levels and academic achievement at the district and state level.

Definition of Terms

To ensure understanding for the reader, the following definitions are used for the purposes of this research study:

**Auditory Language Center.** The vestibular system contributes to the development of word understanding and speech because of its location in the inner ear and interconnections within the brain. The vestibular system helps the brain process what is heard. Increased verbalization frequently occurs following movement experiences.

**Balance.** Being able to maintain a position against the force of gravity.

**Bilateral Integration.** The ability to coordinate two sides of the body and develop hemispheric specialization.
**Binocular Eye Teaming.** Proper focusing of the eyes. One of the basic brain processes involved in reading and it requires integration between the two hemispheres of the brain

**Cognitive Domain (C).** Domain that includes knowledge and intellectual skills.

**Emotional Component.** Experiments have indicated that without vestibular stimulation during infancy animals often grow up to be hostile, aggressive, or withdrawn

**Intersensory Information.** The Vestibular system processes information for all of the other senses such as smell, taste, and especially joint and muscle sensation

**Minds in Motion** – Program developed by Candace Meyer to correlate the entire body into learning

**Muscle Tone.** Firmness of muscles. Increase or decrease in muscle tone affects posture. Child may slouch, have difficulty holding his head up, tire easily, may not like physical activities and may also have problems with reflex development

**National Association for Sport and Physical Education (NASPE).** One of five nonprofit organizations part of the American Alliance for Health, Physical Education, Recreation, and Dance (AAHPERD) now known as Society of Health and Physical Educators (SHAPE). NASPE creates standards for the physical education community

**Oculomotor/Visual Perception.** Weak neck muscles and poor head stability affect the development of normal, smooth eye movements. Child must be able to use his/her eyes together in a smooth, coordinated manner to follow a horizontal line for reading. Child may have to fix his eyes to stabilize and therefore not be able to scan a line or page of print. Child may have difficulty refocusing from chalkboard to desk tasks
**Psychomotor Domain (P).** Domain that includes physical movement, coordination, and motor-skill.

**Reticular Activating System** – The arousal system in the brain stem. This keeps a child awake and alert and conversely can have a calming or inhibiting effect which enables a person to filter out excess peripheral stimuli.

**Sensory Integration.** The process by which we receive information through our senses, organize this information, and use it to participate in everyday activities.

**Society of Health and Physical Educators (SHAPE).** National organization of physical education, sport, dance, and school health professionals. SHAPE creates standards that govern physical education professionals through research, conferences, and workshops that promotes health in society.

**Somatosensory** – of, relating to, or being sensory activity. Having its origin elsewhere than in the special sense organs (eyes and ears) and conveying information about the state of the body.

**Vestibular System** – Commonly known as the balancing system. Coordinates information vestibular organs in the inner ear, eyes, muscles and joints, fingertips and palms of hands, proprioceptors of the feet, jaw, gravity receptors of the skin, adjusts heart rate and blood pressure, muscle tone, limb position, immune responses and arousal.

**Significance of the Study**

There have been very few studies regarding the impact of the Minds in Motion intervention maze on school-aged children. One study (Vidoni, Lorenz, & Terson de Palewille,
2013) pertains to preschool students, but none on the effect that the maze has on elementary school children in terms of auditory memory, reading level, and classroom behavior. The findings by Vidoni et al., (2013), showed that the daily implementation of the Maze approach and stations during a period of 11 weeks had a positive effect on preschooler’s balance and coordination skills, especially in terms of gross motor skills. This study showed that teachers who were trained in the Maze approach found it easy to implement and beneficial for the children.

Another study, (Grissmer, Mashburn, Cottone, Brock, Murrah, Blodgett, & Cameron, 2013), targeted Kindergartners and first graders attending an afterschool program. The findings by Grissmer et al., (2013) focused on the extent of which the Minds in Motion maze impacted children’s development of visuospatial processing, executive functioning, sensorimotor processing, and math skills. Results indicated that the maze increases children’s mathematics achievement without instruction and visuospatial skills that can attribute to mathematics achievement. The study also indicated improvement in executive functioning and attributes to a wide range of children’s academic outcomes.

Although there are significant studies on the effect of movement on academic achievement and behavior, more research on the effect that the Minds in Motion program specifically has on such areas is warranted. As such, the findings of this study will give school districts, principals, classroom teachers, and physical education teachers an opportunity to implement the Minds-in-Motion curriculum into the normal school day. In the treatment of children with vestibular disorders, it is productive to use age-appropriate and fun vestibular-system retraining tasks that appeal to them. For a child-aged (seven or older), this goal may be accomplished with visual mazes or balance obstacle courses (Cronin, 2004).
CHAPTER 2

REVIEW OF LITERATURE

The following review of literature will include research associated with this study and provide an overview about the assessment instrumentation used including the Auditory Digit Span, Developmental Reading Assessment (DRA), and the protocol of office referrals at Columbia Elementary School. Information will also be included about the Minds and Motion maze and any effect it has had on auditory memory, reading level, and classroom behavior. Although there is much literature available on the effect of sensory stimulation on special populations, there is a limited amount of the effect of such on the general population of elementary students and in particular, the Minds in Motion maze.

Minds in Motion Maze

Currently, research on the effects of the Minds in Motion maze is limited. The MIM premise is that there is a link between early afferent neural stimulation and cognitive abilities (Meyer, 2012). The Maze approach is aligned with NASPE Active Start (2009a) and Appropriate Practices in Movement Programs for Children (2009b) publications relating to movement programs designed to aid in the development and refinement of fundamental motor skills during structured physical activity time. It has been implemented in several preschools, elementary schools, and student centers in 12 different states (C.S. Meyer, personal communication, Sept.9, 2017). To date, MIM has generated hundreds of data points that were collected during children’s clinical experiences in its facilities.

An extensive review of the literature produced a research study by Vidoni et al. (2013) which measured the impact of the maze on motor proficiency, namely gross and fine motor skills
in preschoolers. Results showed that there was improvement in both the control and experimental groups with significantly more improvement being found in the experimental group. This study also showed that the maze was easy for teacher’s to implement and beneficial to the students.

Another study conducted by Bray (2015) used a pretest and posttest model and incorporated using the Minds in Motion Auditory Digit Span as a means to assess cognitive function. During a 12-week intervention the auditory digit span scores increased significantly for all students in the study. In this study 12 of the 14 students demonstrated gains larger than what would be expected by maturation and time elapsed alone. This study, like the one being conducted here, focuses on all types of students in an elementary school environment whereas most of the literature review focuses on how the maze effects those who students with cognitive, social, or emotional problems.

Grissmer, Mashburn, Cottone, Brock, Murrah, Blodgett, and Cameron (2011) studied the efficacy of Minds in Motion on Children’s Development of Executive Function, Visuo-spatial and Math Skills. The study focused on Kindergarten and 1st grade students attending an afterschool program and found no significant differences at pretesting, however the Minds in Motion maze increased children’s mathematical achievement, Executive Function, and that visuospatial skills can be improved using the maze.

Another study conducted by Little, Immekus, and Terson de Paleville (2017) focused on determining if conducting the maze activities before school hours resulted in better reading and math scores, classroom behavior and agility, balance and coordination in 4th and 5th grade children in a Spanish Immersion elementary school. Preliminary results show that students
participating in the maze behaved better, some decreasing degrees of ADHD, and had improved
motor control, balance, and coordination.

Angela Smith (2012) researched the effect of the Minds in Motion program on the
reading scores of third grade students. She found that although the Minds in Motion maze might
not have been the primary contributor to reading improvement, the reading scores of the third
grade students did improve.

According to Candace Meyer (2005) research has shown that most mental processes
involve both sides of the brain. Integration problems between the two hemispheres can result
inefficiencies in brain process. Thus, some children with reading problems, central auditory
processing disorders, language delays, and other learning problems may be suffering from a lack
of integration between the two sides of the brain (Belgau, 2013).

Research has proved that poor integration and inefficient coordination between the
numerous brain systems involved in the learning process can be dealt with through sensory
integration and motor development exercises (Schrager, 2001). Exercises that improve balance
through the vestibular system can also improve motor planning, orientation, and behavior (2001).

**Vestibular Stimulation**

Research on vestibular stimulation is in-depth and extensive, especially its effect on
special populations. In terms of its effect on typical elementary students, much research remains.
Research does show that the vestibular system is an important part of the learning process.
According to Niklasson, Niklasson, and Norlander (2010), the vestibular system can be
stimulated through sensorimotor training. According to Kawar, Frick and Frick:
“Without a properly functioning vestibular system, sights and sounds in the environment do not make sense – they are only isolated pieces of information disconnected from the meaningful whole. It is the integration of the sensory information that holds the key for finding the meaning in the world. Because movement is part of everything we do in life, it could be said that the vestibular system supports all behavior and acquisition of skill, as well as helping to balance the stream of sensory information that constantly bombards the system.” (Kawar, et. al. 2005).

It is the first system to develop in utero and to have an organized response to sensory output, is the most protected area of the brain, and has a very close relationship to gravity, safety, survival, arousal, and attention (Greutman, 2014). When a child has an underdeveloped vestibular system, the brain is not getting the correct information from the eyes, ears, and the sense of gravity or movement of the body. This in turn makes the brain and body feel unsafe. When not feeling safe, arousal level, attention, and survival mode responses kick in (Gruetman, 2014). All of which can affect the behavior responses of a child.

Scientific research validates that inefficiencies in the vestibular system can cause academic problems, speech problems, anxiety and stress, panic attacks, self-stimulating behaviors, poor muscle tone, bathroom issues, and behavioral issues (Minds in Motion, 2012). Likewise, Hanes and McCollum (2006) identified cognitive deficits associated with vestibular dysfunction including short-term memory, concentration, arithmetic and reading. Researchers are discovering that stimulating a child’s brain through specific movement activities increases the functioning of the brain, making children more prepared to learn (Berg, 2010; Hannaford, 1995; Jensen, 1998; Meyer, 2005; Vidoni, Lorenz & Terson de Paleville, 2013).
A study by Salamati, Hosseini and Haghgoo (2013), concentrated on the effectiveness of vestibular stimulation on visual attention in children with Attention Deficit Hyperactivity Disorder (ADHD). They found that vestibular stimulation can meaningfully affect the visual attention in ADHD children and that it can be used as a therapeutic technique in treating this population. The study focused on children 7-12 years old with ADHD, were right handed and had a normal IQ.

Most research found in the literature review focused on special populations such as Down Syndrome, Parkinson’s, and those with diagnosed depression. Studies ranged from studying the effects that vestibular stimulation has on balance, expressive language, sensory-motor performance, and cerebral blood flow.

**Sensory Integration**

Sensory integration describes the way the brain works as a whole with the objective of improving functional ability. According to Dr. Jean Ayres in *Sensory Integration and the Child*, sensory integration is defined as:

“...the organization of sensation for use. Our senses give us information about the physical conditions of our body and the environment around us… the brain must organize all of these sensations if a person is to move and learn and behave normally. The brain locates, sorts, and orders sensations – somewhat as a traffic policeman directs moving cars. When sensations flow in a well-organized manner, the brain can use those sensations to form perceptions, behaviors, and learning. When the flow of sensations is disorganized, life can be like a rush hour traffic jam.” (Ayres, 1979)
In addition to Dr. Ayres work, sensory integration studies continue to be conducted and based on the knowledge obtained, modified by researchers such as Restak (1980), Highstein (2004), Meyer (2005), and Niklasson (2010).

There is an abundance of literature on how sensory stimulation effects certain populations, very similar to vestibular stimulation. However, according to several studies involving elementary school students, regular physical activity breaks during a school day may enhance academic performance focus and behavior in the classroom (Trost, 2009). A study by Mahr, Murphy, et al. (2006) showed that providing elementary students with a daily 10-minute physical activity break increased on-task behavior significantly while a break without physical activity decreased on-task behavior. Also, students performed better on reading comprehension, math and spelling when they had a 20-minute period of physical activity immediately preceding the test (Pontifox, 2013).

One study assessed the effectiveness of sensory integration on improving the neuro-physiological capacity of children identified as having learning disabilities (Reynolds, Reynolds, 2010). They found that visual perceptual and visual motor integration were found to improve very significantly and concluded that sensory integration was distinctly effective in improving a child with learning disabilities development.

**Benefits of Physical Activity**

The Center of Disease Control (CDC) recommends 60 minutes of physical activity per day for elementary aged children. Likewise, the 2008 *U.S. Physical Activity Guidelines for Americans* recommended that children and adolescents aged 6 to 17 years should have 60 minutes (1 hour) or more of physical activity each day (CDC Website). According to the CDC,
in the 1960’s 4% of children were obese compared to today where 16% of children are overweight. In addition, the CDC promotes classroom activity similar to that offered by the Minds in Motion maze. Classroom physical activity includes physical activity (e.g. stretching, jumping, dancing) performed in the classroom. It includes integrating physical activity into academic classroom instruction as well as providing breaks from instruction specifically designed for physical activity. Classroom physical activity can take place at any time during the school day, last 5-15 minutes, and occur in one or several sessions throughout the school day. Classroom activity benefits students by increasing their overall physical activity and improving their attention, classroom behavior, and test scores (CDC website). Donelly and Lambourne (2011) stated that children who are fit perform better on attentional tasks that require greater amounts of cognitive control. Including physical activity, or what is known as brain breaks, in addition to recess and physical education can result in improved academic achievement scores and classroom behavior according to the research.

According to the Shape of the Nation report, only 16% of states require elementary schools to provide daily recess (Shape of the Nation report, 2001, p. 3). The American Academy of Pediatrics (AAP) suggested in their 2013 policy statement that recess is a necessary break in the day for optimizing a child’s social, emotional, physical, and cognitive development. They went on to stress that the free play of recess where children can optimize the sensory system with unstructured play, should not be placed by structured physical education classes. A 2009 study found that 8-and 9-year old children who had a least one daily recess period of more than 15 minutes had better classroom behavior (Barros, Silver, & Stein, 2009). This study reinforced a study conducted ten years earlier by Jarrett, Maxwell, Dickerson, Hoge, Davies and Yetley (2009) which found that when 43 fourth graders were given recess, they worked more and
fidgeted less than those who were not given the same recess opportunity. Another study by Haapala, Vaisto, Lintu, Westgate, Ekelund, Poikkeus, Brage, and Lakka (2016) revealed that the less time boys spent being active in first grade, the less improvement they made in reading and math over the next two years.

Debbie Rhea with her research associated with Let’s Inspire Innovation ‘N Kids (LiiNK) has revealed significant findings since 2013. Multiple studies have been conducted that affirms that academic skills and classroom behaviors improve with additional recess during the school day. Studies also indicate that children who spend lots of time outdoors have longer attention spans than kids who watch lots of television and play video games, says Frances Kuo, Director of the Human-Environment Research Laboratory at the University of Illinois at Urbana-Champaign.

**Sensory Integration: Reading, Memory, and Behavior**

Without the vestibular system the body would not be able to control eye movements which is necessary for reading (Highstein, 2004). In a study by Whiton, Singer and Cook (1975), conducted a study on cross-sensory integration skills as predictors of reading acquisition. Supporting evidence indicates that these skills significantly correlate significantly with reading achievement at various grade levels (Birch & Belmont, 1964, 1965; Berry, 1967; Kahn & Birch, 1968; Jones and Aaron, 1971; Reilly, 1971).

Preliminary findings from a study of children with attention deficit hyperactivity (ADHD) show that sensory intervention can significantly improve problem behaviors such as restlessness, impulsivity and hyperactivity (Koenig and Kinnealey, 2005). The researchers found that the children who went through the sensory intervention were more at ease and could better attend to a lesson in a noisy classroom. Likewise, Pontifox (2013) found that after exercise,
brain-wave readings showed that children with ADHD were better able to regulate their behavior and focus and all the children showed academic improvement after brief periods of exercise.

**Sensory Stimulation Programs**

Although sensory integration has been a popular and highly supported subject with babies in the womb, infants, and special populations, some professionals considered sensory integration approaches to be “demonstratively ineffective” models of intervention (Vargas & Camilli, 1998, p.190). This is particularly true for elementary students who do not fall in a special population.

BRAIN GYM, a program consisting of 26 activities recalling the movements naturally done during the first years of life when learning to coordinate the eyes, ears, hands, and whole body, is committed to the principle that moving with intention leads to optimal learning. To date, there are over twenty years of research studies on the effect of this program in different diversified settings. Marpaung, Sareharto, Purwanti, and Hermawati (2017) studied the effect of the BRAIN GYM towards academic performance of children aged 10-12 years and found that the program can increase academic performance of children in the above mentioned age group.

Ready Bodies, Learning Minds is a comprehensive approach to understanding how sensory integration and motor control drives learning and performance in children. Oden, Ready Bodies, Learning Minds, and Kem (2002) ran a study hypothesizing that a motor lab, a prescriptive motor development program focusing on helping children to integrate tactile, reflexive, and vestibular input, is key to academic success. The study was conducted using elementary students. Besides improvement in reading levels, the research group exhibited marked improvement in reflexive integration. The Ready Bodies, Learning Minds extensive
studies also show phonemic awareness improvement in Kindergarten students (Ready Bodies Learning Minds Website).

**Auditory Digit Span Assessment**

There is support in the literature for the use of the Auditory Digit Span assessment as a measure for visual auditory short-term memory (Vance & Singer, 1979). A study conducted by Gathercole and Adams (1993) found it to be, in part, a reliable tool for assessing short-term memory with younger children. Also, in part, the digit span has been found to be a reliable predictor for reading and math achievement (Arcia, Ornstein & Otto, 1991).

Dating back to the 1980’s, the Auditory Digit Span has been evaluated as an instrument for repeated measurement experimentation. Auditory Attention Span is recommended for inclusion in a test battery as a measure of inattention or freedom from distraction and as an indicator of short-term memory or neurophysiological impairment (McCafferty, Bittner, & Carter, 1980). A link seems to have been found between poor readers and low digit spans (Spafford, 1989; Koppitz, 1975).

In multivariate analysis carried out with the 1992 data that controlled for a wide range of demographic and socio-economic variables, the scores of black and Hispanic children were not below those of non-Hispanic, non-black children on the assessment (*The NLSY Children, 1992: Description and Evaluation*). Starting in 1996, this assessment began as a measurement for all children age seven through eleven years old. With twenty-plus years of experienced assessment, the Auditory Digit Span Assessment is a reliable and valid tool for this study.

That is not to say that using the instrument could produce false positives. Traditional results of verbal short-term memory explain differences in performance by one’s previous
experience with memory sequences. In one study, Jones and Macken (2015) doubted this general approach on the basis that short-term memory for digit sequences is superior to that for other sequences of verbal material. Using four different studies, they show that this advantage is not due to inherent characteristics of digits as verbal items, nor are individual digits within sequences better remembered than other types of individual verbal items. Rather, the advantage of digit sequences stems from the increased frequency of the digits. This study raised questions about the role played by measurement of digit span in cognition.

**Developmental Reading Assessment**

A study conducted using the Ready Bodies, Learning Minds program and its effect on reading levels used the Developmental Reading Assessment (DRA). A portion of the results from the study included only pre-first students and a significant difference in reading scores. There was an average 70% increase in reading proficiency in the research group when compared to the control group according to the DRA test results over the 7 month period (Oden, Ready Bodies, Learning Minds, & Kern, 2002).

In summary, the review of literature a wealth of information was found about sensory integration and the vestibular system. However, in terms of finding literature directly relating to the Minds in Motion program, information was minimal. There was only three journal articles obtained through academic searches. Although the researcher discovered much literature in this review pertaining to special populations, very little pertained to typical elementary students.
CHAPTER 3

METHODOLOGY

The descriptive methodology of the study is in this chapter. This includes the participants’ characteristics, informed consent procedures, participant’s rights, and data confidentiality. Further detailed procedural information and its relationship to the assessments use in measuring memory, reading levels, and classroom behavior follows. Additionally, intimate details of the assessment protocols provide directives administering the assessments. Furthermore, the experimental design will provide a detailed description of the protocol for the control group and the intervention group including the gender and grade of the students. Finally, the statistical analysis details the analysis of the factors, levels, and dependent variables including all actual recording forms used to collect the data.

Participants

The research questions in this study focus on elementary students and the development of their sensory system, or lack thereof. The principal’s eagerness to research the effectiveness of the Minds in Motion maze on student success was the primary reason this study occurred at Columbia Elementary School. Other reasons for choosing Columbia Elementary include the following: a) ease of entry; b) high probability that a rich mix of processes, people, interactions, and structures of interest are present; c) the researcher is likely to be able to build trusting relations with the participants of the study; and d) data quality and credibility of the study are reasonably assured (Marshall and Rossman, p. 69).

One of the first grade teachers had previous experience/training with the maze. Thus, with my prior relationship with the principal and the enthusiastic participation of one of the first
grade teachers, I had the potential to build trusting relationships with the other teacher participants and students. With the exception of Kindergarten, the principal encouraged the entire school to participate in the study. Inquiries made at a faculty revealed the teachers having interest in their students participating as the intervention group, thus committing to daily MAZE activity. The more interested teacher from each grade seemed to be the one who volunteered their class for the MAZE (intervention group). Thus, the other class was the control group, responsible for continuing their regular daily activities.

One hundred and eighty-five students, attending grades 1-5 and ranging in age from 6-11 years old, from a Joplin Missouri elementary school served as participants for this study. Marshall and Rossman (1999) describe “site specific” as a study that is “defined by and ultimately linked to that place” (p.68). Of the 185 participating students, nine students (20.5 %) faced removal from the study for non-participation, incomplete data, transferred from the school, or did not attend the required minimum number of completed maze sessions.

During the typical school day, one class from each grade served as the intervention group (n= 91, 52 male; 39 female, mean age = 9.07) participating for twenty minutes in the Minds in Motion maze, broken down into two 10—minute sessions, one in the morning and one in the afternoon. The other class in each grade served as the control group (n= 94, 49 male; 45 female, mean age = 8.80) and continued with their normal school day activities. For purposes of the study, the students in the control group did not have access to the Minds in Motion maze during the conducted time of the study.

The largest segment of this student population consisted of Caucasians (88.1%), a similar ethnic distribution to other schools in Joplin proper. The gender breakdown of the participants is
nearly an equal distribution of male (51.9%) and female (48.1%) students. All students reside in Joplin, a lower-middle class, moderately educated city.

**Participants’ Rights.** This study received formal approval from the University of Arkansas Institutional Review Board (IRB) in compliance with all the institutional and federal regulations concerning the ethical use of human volunteers for research studies (See Appendix A). The principal, teachers, students, as well as parents/guardians of all children in both classes in the first through fifth grade provided consent as well (See Appendix B). In order to protect the participant’s identity, each student had an assigned identification number to assist with data analysis. The study was voluntary and a participant could withdrawal, for any reason and at any time during the study. The researcher and a small research team assisted in collecting data from the pretest and posttest. Each classroom (intervention) teacher ensured that the students attended their respective maze sessions each morning and afternoon, monitoring protocol as they maneuvered through each activity. While the researcher was the only one who had access to the auditory digit span assessment data, the principal and researcher worked closely in collecting the Developmental Reading Assessment (DRA) scores which were used by the school administration and Joplin school district. The same is true for the office referrals as the researcher and principal collaborated on organizing the data.

**Design and Measures**

The researcher conducted a pretest and posttest design for this study. To measure the student’s auditory memory, the researcher utilized the Auditory Digit Span Assessment. The school’s annual reading evaluation, Developmental Reading Assessments (DRA) measured reading level. In terms of classroom behavior, the researcher took into account the number of
office referrals (visits to the principal’s office). Discussion of the assessment instruments and protocol follows as well as how data was gathered and securely stored. Finally, the post study notes from the teacher’s follow-up meeting are included.

Maze. The maze will follow the Maze Handbook approach (Meyer, 2012), which consists of 15- daily stations designed to develop and challenge a student’s balance and learning capabilities. The entire obstacle course takes less than five minutes to complete, thus under the 10-minute specifications of this study, each student should be able to finish at least two rounds during each session. A sampling of the fifteen activities follows, along with a description of the activity, the reasoning behind performing the activity, and the application to the educational setting.

Figure 3.1. Minds in Motion Maze

To accommodate a more elementary setting, the Minds in Motion maze was referred to as the Brain Ninja Maze. Using the appropriate terminology, “Ninja”, students are able to associate
being safe, respectful, quiet, and focused on that of a Ninja cartoon character.

Figure 3.2. Elementary Name for Maze
Station 1: Eye to Eye

*Figure 3.3. Eye to Eye Station*

**Procedure:** Instructor stands in front of a student and moves a pencil with a topper in front of the student’s eyes (approximately 14 inches away) while the student follows the object with his/her eyes. The pencil is moved in the following pattern: 2 horizontal, 2 vertical, 2 circles clockwise, 2 circles counter clockwise, 2 horizontal, 2 convergence training (going in towards nose). **Benefit:** Strengthens eye muscles for eye tracking and eye teaming. **Application:** Increased ocular control providing fluidity in reading and tracking of digits in math.
Station 2: Monster Mash

**Procedure**: Students stomp down hard on padded shapes or blocks laid out on the floor in a pattern. **Benefit**: Provides sensory stimulation through the feet and legs to the brain. Increases sense of balance through proprioceptors located in the feet. **Application**: Enables students to walk, stand, and sit in a controlled manner.
Station 3: Puppy Dog Crawl

*Figure 3.5a. Puppy Crawl*  
*Figure 3.5b. Course Layout*

**Procedure:** Students crawl on hands and knees down on the floor in a given direction for a specified distance. **Benefit:** Develops cross-lateral hand and leg coordination, increases convergence of eyes, and establishes timing in the brain. **Application:** Helps to integrate both hemispheres of the students’ brain for more organized thought.
Station 4: The Electric Slide

![Electric Slide](image1)

![Course Layout](image2)

*Figure 3.6a. Electric Slide  Figure 3.6b. Course Layout*

**Procedure:** Students side-step along a path keeping their toes, hips and shoulders parallel to a wall. In a step-slide motion, students lead with one foot until halfway through the path, then turn so that another foot is leading. **Benefit:** Develops laterality, directionality, and spatial awareness in the brain/body in an integrative whole-body movement. **Application:** Enhances bilateral integration in the brain allowing students to organize their space and time more efficiently.
Station 5: Eye Can Convergence

Procedure: Students hold a beaded string (3 beads affixed to a 4 foot string) in their hand and focus on each differently colored bead one at a time while counting to 10 at each bead. Benefit: Develops eye convergence.

Application: Aids students when focusing on letters and numbers. Creates a strong single vision.
Station 6: Strong Arm Push

*Figure 3.8a. Strong Arm Push  Figure 3.8b. Course Layout*

**Procedure:** Students stand facing wall, then push against the wall with the palms of their hands as hard as they can for ten seconds. The push is initiated straight out from the chest and perpendicular to the wall. **Benefit:** Stimulate proprioceptors (muscles and joints) in the hands and arms. **Application:** Development of fine motor control in handwriting and the ability to copy words on paper while focusing eyes on a sentence written on a chalkboard.
Station 7: Balance Board Bash

**Procedure:** Students stand on balance boards training their bodies to suspend in balance.

**Benefit:** Ensures proprioceptive, visual, and vestibular systems enrich maximum mental processing. **Application:** Aids in optimal visual and auditory processing.
Station 8: The Beam Team

**Procedure**: Students walk on balance beams in a variety of ways in order to develop balance.

**Benefit**: Develops balance and fluid motor control for maximizing brain recalibration.

**Application**: Improves visual-motor control such as: spacing letters and numbers on a line, size constancy of letters, and staying between two lines on paper.
Station 9: Jelly Roll

*Figure 3.11a. Jelly Roll*  
*Figure 3.11b. Course Layout*

**Procedure:** Students roll on a mat placed on the floor in a predetermined manner. **Benefits:** Provides vestibular stimulation to the brain and builds core strength. **Application:** Increases ability to know where they are in space and time; likewise, for perceiving the spatial orientation of an object or a line of print.
Station 10: Climb Every Mountain

*Procedure:* Students step over hurdles or obstacles of varying height. *Benefit:* Develops depth perception while increasing eye-foot coordination. *Application:* Enables eyes to better focus on a page of print.

*Figure 3.12a.* Climb Every Mountain  
*Figure 3.12b.* Course Layout
Station 11: Bean Bag Boogie

Procedure: Students throw and catch a beanbag while walking along a pre-determined path. Students are encouraged to follow the bag with their eyes at all times. Students will progress through several skill levels of throwing and catching during the six sequential weeks. Benefits: Develops eye-hand coordination, focusing, and eye tracking. Application: Developing fine motor control while coordinated use of eyes and hands in writing, board-work, and computer work.

Figure 3.13a. Bean Bag Boogie  
Figure 3.13b. Course Layout
Station 12: Jumping Jack Flash

Procedure: Students perform a standing “broad jump” between two designated lines taped on the floor. Benefit: Develops eye-foot coordination, perfects balance and coordination, and fine-tunes reaction times. Application: Improves reaction time in problem solving and judging distances.
Station 13: Cross Walk

 Procedure: Students slowly walk while touching alternating knees with opposite hands. Benefit: Integrates the brain with bi-lateral coordination movements while crossing the midline of the body. Application: Aids students in bringing their hand to the left margin of their paper for writing assignments and speeds up brain processing.
Station 14: Skip to My Lou

*Figure 3.16a* Skip To My Lou.  *Figure 3.16b.* Course Layout

**Procedure:** Students skip down a designated line while swinging their arms cross-laterally in an exaggerated fashion. **Benefit:** Develops cross-lateral integration of brain hemispheres and motor development. Emphasizes opposite arm/opposite leg movement in a rhythmic and controlled manner. **Application:** Enhances muscle memory in students increasing learning capabilities and ease in accomplishing tasks.
Station 15: Step Back

**Figure 3.17a. Step Back**

**Figure 3.17b. Course Layout**

**Procedure:** Students walk backwards up a set of stairs holding onto a rail for support. **Benefit:**

Develops whole-body coordination, motor planning, and depth perception. **Application:**

Develops ability to do things without looking.

*Excerpts taken with permission from The Maze Handbook. 15 Developmental Steps for Brain/Body Integration (pgs. 9-22), Minds in Motion. Minds in Motion Inc. Press, 2012, Louisville, KY. Copyright 2012 by Candace Meyer.*

**Modifications to the MAZE.** Progressions made to week one of the maze activities (Appendix H) allow for differentiation of movement and eclectic stimulation throughout the study. Weekly changes noted next to the appropriate movement pattern represent the modification in activity whereas a blank space indicates no change in the movement.
**Intervention preparation.** Prior to the study, the teachers received Maze training involving several different teaching strategies. A first-grade teacher, who attended a MIM Training Workshop, taped her first-grade class from the previous year as they performed all 15 Maze activities. This video provided the teachers and students visual demonstrations of proper Maze protocol. The training consisted of background information about the program, a daily morning/afternoon participation schedule for each class, and an outline of weekly changes to the maze. The teachers also received weekly email reminders full of helpful tips and reminders. The Maze, set up appropriately at the beginning of the intervention period, remained set up throughout the duration of the study. On Monday morning of each week, the researcher made the necessary changes for the weekly activities. Although the researcher does not believe that it will be necessary, an equipment list and maze diagram accompanied each teacher.

In order to verify the Maze set up is correct and the children taught the correct procedures, Minds in Motion Founder, Candace Meyer received the instructional video for critical review. Aside from a few minor revisions, the maze was appropriate for the study. This ensured a more reliable and valid study.

The researcher and a first grade teacher worked together to assign consistent morning and afternoon time slots for each intervention class to complete the maze with the least amount of disruption to the student’s normal daily routine. The research schedule (Table 1) provides a general overview of the time line for this study. This study will follow a pre-test/post-test design where the Minds-in-Motion intervention maze will begin after the pre-test has concluded and continue throughout the six weeks and followed by a post-test. The six-week MIM maze curriculum along with weekly implementation of maze changes and challenges is included (see Appendix E for weekly lesson plans).
This study obtained Institutional Review Board approval and consent from the principal, classroom teacher(s), students, and parent(s) or guardian(s) (see Appendix A and Appendix B). The primary function of participants’ rights is to protect the identity of those students who chose to participate in the study. For further identity protection, each student is assigned an identification number for coding purposes and data analysis. Each student participated voluntarily and for any reason, could choose to decline to participate or withdrawal from the study at any time even after signing the informed consent. All research data, kept secure and confidential is located on an external thumb drive. After a five-year period, student assessments and consent forms are shredded and the thumb drive erased.

An Excel spreadsheet and Statistical Package for Social Sciences (SPSS) version 23 software contains all collected data.

*Intervention group.* Under the supervision of the classroom teacher, the students in the intervention group participated in structured physical activity time for 6 weeks and will consist of two 10-minute bouts of activity using the 15 movement activities provided in the Maze. Each child will start the maze at a pre-assigned station to ensure that all children will be participating with effectiveness and time efficiency. This is ensure maximum participation without the students waiting in line for their turn or for the use of equipment. For timing purposes, the classroom teacher will monitor the class by timing the students for 40-seconds at each station. This will occur during the first week of the study and will ensure that students are spending enough time at each station, thus creating a rhythm of activity for the remainder of the study.

The activities will take place in a hallway connecting the main school building with the gymnasium. The intervention will consist of 30 sessions, every day (once in the morning and
once in the afternoon). Each class, given a timed schedule, ensures that the intervention group will be going to the hallway to participate in the maze at the same time every day. With one minute remaining in each session, the teacher will take the children to a staircase located approximately 30 feet from the hallway where they will step backwards up and down the staircase while holding on to the railing.

All teachers will receive a six-week plan based on the Maze Handbook prior to the intervention sessions. Every Sunday, an email with changes and additional challenges will be sent to all teachers via email. They will be instructed to notify the children of such changes on Monday before beginning the maze and to keep such added activities for the remainder of that particular week. Monday’s sessions will need verbal instructions, demonstrations, cues, and feedback due to the changes and new challenges in the program. During the remainder of the week cues, feedback, and additional demonstrations are not to be delivered unless absolutely necessary. The goal is to let the children explore, adapt, and experience the tasks according to their motor development needs.

**Control Group.** While the intervention group received structured movement in the maze for 20-minutes per day (two 10-minute increments), the control group participated in their regular school-day activities. These activities include: academic classroom activities, unstructured recess, art, music, and other activities typical of students attending an elementary school.

During the normal school day, one class per grade will be a control group (n=94) and the other class the intervention group (n=91) that will be participating in the MIM Maze for 20 minutes, broken down into ten minutes during a pre-scheduled time in the morning and ten
minutes again in the afternoon. To eliminate absences from factoring into the data collection, teachers will be instructed to have each child complete the daily maze (20 minutes total) thirty (30) times during the six-week intervention phase. For purposes of this study and to assure the most reliable and valid data, students in the control group will not have access to the Minds in Motion maze during the study, but rather will be given permission to participate in the Maze during the following semester.

The classroom teacher(s) and research team will assist in data collection (pretest and posttest tests) and the classroom teacher of each grade will observe the Minds in Motion maze, but will not have access to the data once the data is being prepared for analysis. However, since the school uses the DRA testing as part of the district’s reading assessment, the participants pretest and posttest results are used by the administration for such purposes.

Assessment Instrumentation

In this section, the researcher will discuss the three assessment instruments: one to be used to assess memory, one assessing reading levels, and a third tracking classroom behavior. Justification on the selection of such assessments and protocol required to administer the assessments is also be covered.

**Auditory digit span assessment.** The following section details the instrumentation protocol to administer the assessment tools for measuring memory, reading levels, and classroom behavior in children for this study. The researcher selected assessment instruments to measure auditory memory, reading levels and classroom behavior in children for this study. The first instrument selected was the Auditory Digit Span Assessment (MIM, 2016). This instrument was chosen because of its previous use with the Minds in Motion maze and use in other Minds in
Motion studies. Auditory memory involves being able to take in information that is presented orally, to process that information, store it in one's mind and then recall what one has heard. It involves the skills of attending, listening, processing, storing, and recalling. Because students with auditory memory weaknesses pick up only bits and pieces of what all is verbalized during a classroom lecture, they make sense of only little amounts of what is said by the teacher. Afterwards they are able to recall only a small amount or none of what was said (Cusimano, 1998). Not being able to take in verbal instructions, processing, and responding to a teacher’s voice, whether it be through giving directions, laying out behavioral expectations, or instructing would be troublesome to both academic achievement and classroom behavior. Students with auditory memory deficiencies will often experience difficulty developing a good understanding of words, remembering terms and information presented orally, for example, in history and science classes (Cusimano, 1998).

The Auditory Digit Span Assessment can also help in determining reading levels, especially in terms of reading comprehension. These students may experience difficulty processing and recalling information that they have read to themselves. When we read, we must listen and process information we say to ourselves, even when we read silently. If we do not attend and listen to our silent input of words, we cannot process the information or recall what we have read. Therefore, even silent reading involves a form of listening (Cusimano, 1998). A poor auditory short-term memory is often the cause for a child's inability to learn to read using the phonics method (Ringoen, 2001). Phonics is an auditory learning system, and it is imperative to have a sufficient auditory short-term memory in order to learn, utilize and understand reading using the phonics method (Ringoen, 2001). According to Ringoen (2001), in order to begin to
utilize phonics beyond memorizing a few individual sounds, a child must have an auditory digit span close to six.

Auditory memory is probably the most prevalent but most often overlooked learning skill deficiency, says Addie Cusimano, author of the book, *Learning Disabilities: There is a Cure* (2002). Throughout my years of testing, I have found a higher percentage of students with weaknesses in the auditory memory areas than any other learning skill area, even among those students whom we would not classify as learning disabled. In addition, most children who have attention deficit disorders and/or hyperactivity have serious auditory memory deficiencies. These children are desperately in need of remediation in the auditory skill areas (Cusimano, 2010). For purposes of the study, students repeated a series of numbers dispensed by a computerized auditory program. The assessment began at two numbers and proceeded up to seven. Six columns of ten words made up the assessment. Collected data included the difference in the number of lines a student repeated correctly after obtaining three errors. This difference included the line number of the pretest and the posttest.

*The developmental reading assessment (DRA).* The DRA Assessment is a test given four times a year that measures student's reading proficiency through observation, recording, and evaluating of performance. The test involves a process of observing a student’s reading engagement, analyzing and recording oral reading fluency, and evaluating the comprehension level of the student. The researcher chose the DRA because it is a proven, criterion-referenced assessment and is supported by sound validity and reliability analyses. This study will use the student’s reading level score, a composite score of the student's accuracy, oral reading fluency and comprehension levels.
The DRA includes four stages: Emergent, Early, Transitional, and Extending. Although Emergent classification is for Kindergarten only, the other stages blend. For instance, first graders could fall in the Emergent or Transitional stage whereas second graders could land in the Transitional or Extending stage. Like Kindergarten, third grade readers fall only in one stage, in this case it is Extending. The next stages are Early Fluent and Fluent and are more abreast to those students in fourth and fifth grade. DRA Levels range from A – 40. The levels A and 1-3 fall in the kindergarten grade and the Emergent Stage. The next set of numbers are in multiples of two and range from 4-20 falling into both the Early and Transitional stages. In the Transitional and Extending stages the numbers fluctuate between multiples of four and two ranging from 20-40 (Appendix 4). The remainder of the levels are either 40 or 44. Forty being for fourth grade and forty-four for fifth grade. The DRA contains three subsets: Instructional, Independent, and Advanced. Each characterizes a student’s ability to read with accuracy, comprehension, and fluency. At each point, ranks based on the level of assistance a student requires to read with accuracy, comprehension, and fluency.

Each DRA assessment occurs during one-on-one reading sessions between the teacher and student. A series of texts are used, each increasing in difficulty. Each classroom teacher will be giving their own students the reading assessment. It will be given in one sitting because only a minimal number of students can be tested each day. Thus, the test will be administered in all grade levels during the week prior to the intervention period beginning and immediately after the intervention period concluding. The principal will collect the DRA results and provide them to the researcher.

**Think sheets and office referrals.** In terms of assessing classroom behavior, a two-step protocol is used. The first is known as Think Sheets and is utilized at the elementary school to
document inappropriate classroom behavior. Following the Behavioral Flow Chart provided by the administration to each of the teachers at the beginning of the school year, teachers decide when a behavior requires the Think Seat. The Think Seat is located in the Principal’s office, removing the student from the undesired situation and allowing ample time for them to reduce their stress level and reflect upon the occurrence. It also enables the administration and teachers to assess whether or not the student is capable of returning to the classroom setting.

After a brief cooling-off period, the student is required to complete a Think Sheet (See Appendix H). This self-reflection and processing activity forces the student to think about what incident just occurred, why it took place, how it could be handled in the future (if the same incident occurred), and whether or not the student believes he/she is ready to return to the classroom. The number of Think Sheets six weeks prior to the date of the maze initiation will be collected. This total is compared to the number of Think Sheets given to students, both in the control and intervention groups, during the intervention period. These office referrals are usually for grievances deemed more serious and usually result in consequences for the student such as in-school suspension, removal from lunchroom, removal from recess, conference with counselor, conference with parents, etc. The number of office referrals from the beginning of the semester to the date of the maze initiation will be collected as well as the number of office referrals given during the intervention period. The Think Sheets and Office Referrals will be collected from the principal on the Friday before the maze begins and counted. The documented offense will account for the severity of the incident.
Experimental Design

Table 3.1

Research Schedule

<table>
<thead>
<tr>
<th>Time Line</th>
<th>General Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Pretesting of Control and Intervention Group</td>
</tr>
<tr>
<td>Weeks 2-5</td>
<td>Intervention Period</td>
</tr>
<tr>
<td></td>
<td>• Control Group: Attend regularly scheduled classroom sessions</td>
</tr>
<tr>
<td></td>
<td>• Intervention Group: Regularly scheduled sessions with intervention maze</td>
</tr>
<tr>
<td>Week 6</td>
<td>Post testing of Control and Intervention Group</td>
</tr>
</tbody>
</table>

Note. * See Appendix I for detailed lesson plans.

Week 1 pretests. Before students start the MIM maze, students in the control and intervention groups will participate in a series of pretests. The memory test will be conducted over a two-day period by the researcher and volunteer students from the Kinesiology Department at Missouri Southern State University to ensure reliability and validity of the results. Four stations will be set up in the gymnasium. Flexibility is paramount as these stations can move to other locations such as the library, hallway, or school cafeteria based on the needs of the school day. At those stations, a computer will say aloud the numbers to the students using an application known as Read and Write. This program ensures that the students hear the numbers in a monotone, computerized voice as to not give human voice cadence inflections to the numbers, which could enhance memory recollection. The elementary students will continue to repeat the numbers heard (2-digits through possibly 7-digits) until they encounter three (3) incorrect
responses. Calculation of the score occurs by adding the number of lines a student gets correct up to, but not including the third error.

The Developmental Reading Assessment is conducted within one week of the intervention stage beginning and concluding. Each respective teacher gives the test to the students in their class. The Think Sheets and Office Referrals are tallied as they occur during the entire study period.

**Week 2-5 intervention period.** During the intervention period, the control group will conduct school business as usual, without disruption to their daily class routine/schedule. During this time, they will participate in regularly scheduled curriculum. The control group cannot participate in any sensory stimulation maze activities throughout the course of the eight-week study. The intervention group will participate in the Minds in Motion Maze. Per written permission given by the founder of Minds-In-Motion the set-up of the maze was evaluated as well as the procedural instructions of the maze to ensure commonality between the maze setup and how the activities are explained to the students. This will assist in the validity and reliability of the study. The students will participate in the maze during the entire 6-week period for 10-minutes in the morning and 10-minutes in the afternoon. Each activity station provides a name, equipment to be utilized, and explanation. Weekly changes will be made to some of the stations, increasing the skill level and intensity. Table 2 provides an overview of the weekly activity schedule and Appendix E details each activity administered during this study. Additionally, all vestibular stimulation activities are performed indoors through the course of this study.
Table 3.2

Challenges/Changes Overview

<table>
<thead>
<tr>
<th>Week</th>
<th>Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to original Minds in Motion (MIM) Maze</td>
</tr>
<tr>
<td>2</td>
<td>Bean Bag Boogie, Beam Team</td>
</tr>
<tr>
<td>3</td>
<td>Bean Bag Boogie, Jelly Roll, Beam Team</td>
</tr>
<tr>
<td>4</td>
<td>Bean Bag Boogie, Jelly Roll, Beam Team, Strong Arm Push</td>
</tr>
<tr>
<td>5</td>
<td>Bean Bag Boogie, Cross Walk, Beam Team, Strong Arm Push, Step Back</td>
</tr>
<tr>
<td>6</td>
<td>Electric Slide, Bean Bag Boogie, Balance Board Dash, Climb Every Mountain, Beam Team</td>
</tr>
</tbody>
</table>

Note. See Appendix E for detailed lesson plans and challenges.

**Week 6 posttests.** At the end of the intervention period, a series of posttests will be given to re-measure the student’s memory, reading level, and behavior. The posttests will be conducted by the researcher, MSSU Kinesiology student volunteers, and classroom teachers. We will follow the same two-day protocol established in the pretesting.

**Statistical Analysis**

The Statistical Package for Social Sciences (SPSS) version 23 will be utilized to analyze the descriptive statistics for this study. Data will be displayed as group means and standard deviations. A MANOVA will be conducted to evaluate the relationship for each of the three factors: memory, reading levels, and classroom behavior. Each factor consists of two levels to include a control group and intervention group. The dependent variable for this study is the difference in posttest minus pretest testing scores of auditory memory, DRA reading levels and office referrals. An alpha set at .05 will define the significance for all tests.
In this chapter, the researcher addressed the methodology details for this study. The researcher discussed participant selection and how the identity of the participant will be kept confidential and how the data will be managed. The researcher shared how participants will be selected to form two groups; a control group and an MIM Intervention Maze group. The assessment instrumentation section provided details about what assessment instruments are conducted for auditory memory, reading levels, and classroom behavior. Discussion as to why they were selected for this study and the protocol for implementation was also mentioned. The experimental design details the pretest, intervention period, and posttest for the course of this study. Finally, the researcher addressed how a MANOVA analyzed each of the three factors presented in this study.
CHAPTER 4
RESULTS

The following detailed results for each of the three research questions and their respective hypotheses determine the effect of the Minds in Motion maze on auditory memory, reading levels, and classroom behavior in first through fifth grade elementary students. This information will provide data that is pertinent to the three research questions addressed at the beginning of the study. Each of the data points separate into the following categories: auditory memory scores, composite reading scores, and the number of office referrals administered both outside of and during the intervention period.

Sample Analysis

Prior to final analysis, the sample population was analyzed to determine their viability for use during analysis. Participant’s attendance was evaluated first. Namely, this recognized those students who were absent the day of the pretest or posttest and/or did not fulfill the eighty percent minimum maze participation rate. Daily attendance, recorded by the teacher during the intervention period of this study, included week, day, and am/pm sessions (Appendix M). Teachers marked an X in a small box indicating the student’s participation in the maze for that particular session. There was also space at the bottom of each sheet for teacher’s notes/observations. Some of the students eliminated themselves due to extended absences due to illnesses or family issues, withdrawal from school, or inconvenient absence during the critical aspects of the study (pre and post testing).

The examination for extreme outliers also occurred, with recognition of none. Although there was one outlier per assessment, exploratory data analysis revealed that such students did not impact the study results to be removed. Participants, who did not meet the 8 out of 11
sessions (80%) attendance, had their data removed from final analysis. After a review of the attendance records, \((n=176)\) students met the attendance requirement. The attendance rate of the intervention by grade is as follows: first grade- 95.50\%, second grade- 96.96\%, third grade-93.44\%, fourth grade- 88.89 \%, and fifth grade- 96.07\%. Next, participants were removed from the analysis due to pretest and/or posttest absences. Removed from data analysis for missing data were nine auditory digit assessments and five Developmental Reading Assessment (DRA) tests. Prior to and during this study, a few participants identified extreme situations that positively or negatively skewed the analysis. Examples of some of these situations involved students reaching the maximum threshold on the auditory assessment or failing on the first three attempts. In terms of office referrals, the same student in the intervention group repeated poor behavior possibly due to improper handling of family issues occurring during the bulk of the study. However, as mentioned previously, such incidences did not bring any significant changes to the results.

**Hypotheses Results**

This section will report the results for each of the hypotheses to investigate the effects of the Minds in Motion maze. The three hypotheses \((H_i)\) are as follows:

1. to what extent does the Minds-in-Motion intervention maze affect the auditory memory of elementary students as measured by the Auditory Digital Span assessment,
2. to what extent does the Minds-in-Motion intervention maze affect the composite reading levels of elementary students as measured by the Developmental Reading Assessment (DRA) and
3. to what extent does the Minds-in-Motion intervention maze affect the classroom behavior of elementary students as measured by number of office referrals and degree of offense.
Table 4.2

Means and Standard Deviations for the Control and Intervention Groups

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Control</th>
<th>Intervention</th>
<th>Control</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
</tr>
<tr>
<td>Auditory Memory</td>
<td>91</td>
<td>1.87</td>
<td>4.45</td>
<td>83</td>
</tr>
<tr>
<td>DRA Levels</td>
<td>91</td>
<td>4.95</td>
<td>4.634</td>
<td>83</td>
</tr>
<tr>
<td>Office Referrals</td>
<td>91</td>
<td>.0330</td>
<td>0.567</td>
<td>83</td>
</tr>
</tbody>
</table>

\[ R^2 = 0.26 \text{ (Adjusted } R^2 = .021) \]
\[ R^2 = .001 \text{ (Adjusted } R^2 = .005) \]
\[ R^2 = .021 \text{ (Adjusted } R^2 = .015) \]

**Hypothesis results.** A one-way multivariate analysis of variance (MANOVA) was conducted to determine the effect of the three independent variables (auditory memory, reading level, and office referrals) on the two dependent variables, the control (treatment) group and the intervention group (Table 4.1). In addition, the Wilks’ Lambda was conducted in order to determine how much variance there was in the dependent variables as related to the independent variables (control and intervention). For each group the data output signifies how much variance for each dependent variable is associated with the intervention (or maze).

The MANOVA tested whether or not there were differences between group means for each dependent variable (Table 4.1). The researcher was looking for a value of 0 on the Lambda as such would have signified there was no variance and a small p-value less than or equal to 0.05, signifying a 95% confidence interval. The researcher found significant differences were found among the three assessments on the dependent measures, Wilks’s \( \Lambda = .95, F(3,170) = 2.95, p = .034 \). The multivariate \( \eta^2 \) based on Wilks’s \( \Lambda \) had a small to moderate association with
the group factor, .05. A two-sample T-Test for each assessment found that there was significant positive difference in one assessment (auditory memory), significant negative difference in one assessment (referrals) and no significant difference in the third assessment (reading level).

The Developmental Reading Assessment (DRA) results demonstrate that the intervention did not have a significant effect on the intervention group as compared to the control group (Figure 4.2). If the null hypothesis states that there is no significant difference between results in the control group and results in the intervention group, then the P-value of 0.616 (Figure 4.2) clearly validates that the null hypothesis cannot be rejected.

*Table 4.2. Summary for DRA Difference by control and intervention groups.*
For Auditory testing, the results demonstrate that the intervention did have a significant positive effect on the auditory results as compared to the control group (Figure 4.3). Specifically, the results show that the intervention resulted in improvement of at least 2 points higher than that of the control group. If the null hypothesis states that there is no significant difference between results in the control group and results in the intervention group, then the P-value of 0.029 (Figure 4.3) validates that the null hypothesis can be rejected and a significant difference does exist.

![Bar graph showing mean AUD difference between control and intervention groups.]

**Table 4.3.** Summary for Auditory Difference by control and intervention groups.

For Behavioral testing, the results demonstrate that the intervention did have a significant negative effect on the results as compared to the control group (Figure 4.4). Specifically, results show that the intervention resulted in more referrals based on the mean values. If the null
hypothesis states that there is no significant difference between results in the control group and results in the intervention group, then the P-value of 0.967 (Figure 4.4) fails to reject the null hypothesis and points to the inverse of desired results. Therefore, the results of this study might suggest that the intervention had a negative effect on behavior.

Table 4.4. Summary for Behavior (Referral) Difference by control and intervention groups.

Post hoc analyses to the univariate ANOVA for the control and intervention scores was unnecessary since all ANOVAS reported non-significant findings between the auditory memory, reading level, and office referral scores. Figure 4.5 shows the distribution of the two levels for the auditory digit span assessment. Figure 4.6 shows the distribution of the two levels for the DRA reading levels and the office referrals are referenced in Figure 4.7.
Finally, an interaction plot was run for each of the assessments to understand the effect of the intervention for each grade level. Comparing the control group mean and the intervention group mean for each grade to determine effect, the interactive plot provides a clear picture of the results. For the DRA assessment, all grades but grade one displays non-significant change (Figure 4.8). Grade one results conclude that the intervention actually had a negative effect on the mean of the differences.

Table 4.5. Interaction Plot for DRA Difference

The interaction plot for the auditory assessment shows a moderate positive change for three grade levels, a slight (insignificant) positive change for one grade level and a slight negative change for one grade level (Figure 4.9). Grades one, three and five saw the positive effect from the intervention while grades two and four experienced almost no effect.
Table 4.6. Interaction Plot for Auditory Difference

For the referral interactions by grade, nearly every grade experienced an upward trend when comparing the means of control versus intervention, respectfully. In this case, the higher mean value of the intervention group is the inverse of desired results. Grades two, four and five experienced more referrals in the intervention group. Moreover, there was a slight difference between the control and intervention groups in grades one and three. Only grade three saw fewer referrals in the intervention group than in the control group. However, the differences for all groups were insignificant.
Table 4.7. Interaction Plot for Referral Difference

**Teacher Follow-Up Meeting Minutes**

This section details the meeting notes from the follow up teacher’s meeting. The participating teachers volunteered to attend a short informative meeting one week after conclusion of the six-week study in order to solicit impressions and observations of the Minds in Motion maze and to discuss possible improvements for future research studies. The first and third grade teachers associated with the intervention group stated that they saw an improvement in classroom behavior after participating in the maze. The teachers in second, fourth, and fifth grades did not seem to notice a difference in behavior. All intervention group teachers believed in the connection between sensory stimulation and academic improvement seeing growth in their classrooms.

All teachers believed having a longer intervention phase would make the maze very effective. For example, having the students participate in the maze over the course of an entire
semester rather than just six weeks would provide more opportunities for the students to participate in and solidify the maze movements. Likewise, being able to purchase more equipment would allow the maze to be more challenging for students, especially those in the fourth and fifth grades. Lastly, some stations needed to be adjusted to fit the narrow hall space provided for the maze set up which in turn would make it more efficient for the students to complete more rounds in the time allotment.

According to the teachers some issues that arose during the study included protocol during the maze participation. The fifth grade teacher thought that his students “played” too much and would have preferred more challenging stations associated with the maze. This request would have possibly been met had the intervention phase lasted longer and more of the maze challenges been implemented. Teachers unanimously thought that the students went through the stations too quickly and requested that the 40-second time intervals for each station be part of the teacher’s responsibility not only during the first week, but also during every maze visit.

Another issue was effort. Effort was an intangible element that was hard to measure as some students did not put forth the energy required to see significant improvement. They mentioned that some incentive program such as naming a “Ninja of the Day” would help improve behavior and that when they randomly videotaped their students, students were more motivated to work hard during the stations. The final recommendation was that one person be responsible for the maze, a person who knew all the students well, could motivate them to give their best, and give extra support to those students who need it most.
The comments by the teachers demonstrate that the Minds in Motion maze can be an easy brain break for all students and can improve a student’s academic performance and classroom behavior. More significant findings could occur with simple modifications to the implementation of the maze.
CHAPTER 5

DISCUSSION

The purpose of this quantitative study was to investigate the effect of a sensory stimulation maze on auditory memory, reading levels, and classroom behavior in first through fifth grade students in a Joplin, Missouri elementary school. To investigate the effects of a sensory stimulation maze know as Minds in Motion, three hypotheses were developed to test for significance. Those hypotheses are as follows: (1) to what extent does the Minds-in-Motion intervention maze affect the auditory memory of elementary students as measured by the Auditory Digital Span assessment, (2) to what extent does the Minds-in-Motion intervention maze affect the composite reading levels of elementary students as measured by the Developmental Reading Assessment (DRA), and (3) to what extent does the Minds-in-Motion intervention maze affect the classroom behavior of elementary students as measured by number of office referrals. The following section discusses the results of the study, any conclusions that were came from those results, limitations that arose and recommendations for future studies.

Discussion

Students were invited to participate in this sensory stimulation study during their normal school day. The intervention period covered a 6-week period. Teachers for the intervention group scheduled for their students to participate in the Minds in Motion maze activities for 20-minutes per day, ten minutes in the morning and ten minutes in the afternoon. During the intervention period, the control group (Table 3.2) participated in normal elementary school day activities including, but not limited to classroom academics, reading, art, music, and recess. The
goal of this study was to have the control group not deviate from the normal school day activities in order to ensure that the researcher kept out biases in the results.

The intervention group followed a specifically designed Minds in Motion Maze curriculum. Through an extensive review of literature, it was evident that only a few studies had been conducted using the maze. The review also produced limited evidence that the maze curriculum was used to research its effect on all three variables in this study: auditory memory, reading levels, and classroom behavior. Thus, the curriculum designed for this study was taken from the first six weeks of the Minds in Motion curriculum, with permission, from Minds in Motion (Appendix H). Using this curriculum ensured participant consistent activity over the 6-week intervention period.

One assessment, the Auditory Digit Span Assessment was used from the Minds in Motion program while the Developmental Reading Assessment (DRA) was used due to its convenience as the reading assessment for the Joplin school district. The office referrals were a consistent and obvious measurement of student behavior that could be tracked by the principal on an every occurrence basis.

Implementing the maze in an elementary school setting is challenging due to the age of the children and the amount of stimuli they are subjected to in their educational environment. In essence, the real world contributes to a loss of control that could have been eliminated had the study been conducted in a lab under controlled settings. These challenges pose an interesting scenario in attempting to discover what contributes to or hinders the improvement rate of children in this setting. However, the researcher set up the maze in the same location and the classes were scheduled for predetermined times during the day in order to allow many of the
independent variables to stay consistent and uninterrupted due to weather or overlapping responsibilities.

**Auditory memory.** Rothschild (2000) argued that memories have a sensory basis and the memory of an earlier event may be elicited if it is stimulated by a similar event. While the study’s findings reported the results to be non-significant for auditory memory, further exploratory investigation of the results found that both the control and intervention groups demonstrated an improvement in their auditory memory scores illustrated by the means of the pretest and posttest scores. According to Wolfe (2001) a one digit span increase over two years was considered typical growth in children.

A review of literature was conducted to find comparable research on how the Minds in Motion maze affects the Auditory Digit Span Assessment scores. While the review produced no comparable research related to certain child populations, the review did produce a study on the effect of the maze and auditory memory on Pre-K and Kindergarten students. The study’s findings showed that there could be significance in other populations tested. Memory is retrieved better when learned through movement (Meyer, 2005). Another study (Bray, 2015) indicated that the auditory digit span number increased in all students during a 12-week intervention period indicating that had more time been implemented for this study, the minds in motion maze could have had more of an effect on the auditory memory of children.

The Minds in Motion curriculum enabled the elementary students in the intervention group to increase their exercise time by twenty minutes each day which enabled them to meet a portion of their daily requirement of 60 minutes of moderate physical activity (SHAPE, 2014, 2016; AHA, 2014). Considering that most of the students were participating in the maze
activities for the first time, more experience in the maze could result in improved cardiovascular stamina as the maze curriculum develops more challenging skill progressions. Since, in the literature review it is evident that physical activity positively affects overall brain function, the auditory digit span assessment was a viable assessment for measuring memory. The interconnection of processing and storage is demonstrated in this cognitive activity, and an increase in this measure suggests an increase in this function (Wolfe, 2001).

In this study, only one student completely completed the posttest auditory digit span assessment completely through all the numbers, concluding with seven digits. One other student was on the opposite end of the spectrum, missing the first three lines of digits in the pretest. These extremes however, did not have a significant impact on the outcome of the results one way or another.

**Reading level.** The results suggest that the effect that the maze had on reading levels was insignificant. These results do not take into account that there could have been improvement in reading levels, but just not evident through the assessment used. There are a few speculative theories as to why this may have occurred. First, the finding suggests that although there may have been improvement in reading levels because of maze activity, the way in which the Developmental Reading Assessment (DRA) measures improvement is in levels not congruent amongst all grade levels thus students could have improved in reading but had not progressed to the next level. If the DRA is used in future studies, it would be beneficial to use the components of the assessment, reading fluency and reading comprehensions as the measurement for reading improvement, instead of levels. One other suggestion would be to convert the level scores to a matrix converting composite scores into percentiles. Another theory is that there may not have been significance due to the reading activity of the students in the control group. Although all
students read in their normal classroom activities, the control group could have been allotted more reading time while the intervention group was performing the maze. Since the control group could have spent a total of 6 more hours reading while the intervention group participated in the maze, their reading scores could have been influenced more which may have diluted the non-significant results for the maze. Although the likelihood of such would create dramatic differences, it does need to be taken into consideration. Another reason as to why there was no significance compared found is in conjunction with Columbia elementary being a very low functioning academic school, especially in terms of reading proficiency thus both the intervention and control groups showed improvement due to the emphasis placed on reading by the principal at the beginning of the school year.

**Office referrals.** The non-significant results of classroom behavior is contrary to the information obtained in the literature review. No formal evaluation was done on improved focus and completed work, however some improvement was noted by the teachers in this study especially for those in the higher grade levels. The floor effect played into the results of the office referrals. Since the number of office referrals were minimal, any profound activity would have been difficult to overcome. An example of this is the one student in the intervention group who had seven office referrals during the intervention period of the study.

The lack of improvement seen in behavior could have been due to a number of factors. First of all, the intervention stage took place in the middle of the semester, which according to the principal is the time of the year that most poor behavior occurs. The principal went on to say that the teacher’s subjectivity in handling discipline also tends to change throughout the school year. For instance, children are less likely to misbehave in the first month of a semester and the teachers tend to be more lax in their discipline, thus dealing with most behavior problems in their
classroom and not sending students to the office. The same is true for the end of the semester. Most teachers are more tolerant than they are in the middle of the semester because the end is near. Had the researcher shifted the study to be conducted a few weeks earlier in the year, results could have shown an improvement in behavior. Another factor was the assessment instrument used. Using office referrals only signified a small portion of behavior issues – the more extreme cases. Had the researcher used a more broad approach, such as classroom observation, the results could have shown improvement.

Besides behavior, other limitations provided additional issues during the study. One limitation related was the pretest posttest designs that require participants to perform at their “best” during the testing time periods. This could negatively impact the results when a participant under performs when not feeling well, is unfocused or has low performing day. During the auditory digit span pretest and posttest evaluations it was observed by the researcher and evaluation team and confirmed by the principal that some students may not have performed at their best due to the location of the testing. Because of the fluid environment of an elementary school, some students performed their pre or posttest in high traffic areas such as a hallway or the corner of the cafeteria. In most cases, a student did not perform both the pre and posttest in the same environment. In future studies, providing a quiet and consistent location for testing could improve the results of the study.

The next limitation identified was the assessment used to test reading levels. The researcher chose this method because of its history of being a valid and reliable reading assessment tool. However, the Developmental Reading Assessment (DRA) does not provide a percentile score to be used for comparative means. Reading levels are used, levels which fall under a wide range of grades and reading experience. This created a situation where students
could have improved their reading level, however such was not indicated by a movement from one reading level to the next. In future studies, using another assessment could display different results. Using Class Dojo as a classroom behavior-management system is recommended. In having the teachers set the same criteria in managing classroom behavior and consequences, a more accurate measurement of behavior could be collected and measured on a more objective scale. Perhaps using a Likert Scale on behavior could have been used to ask each of the teachers to rate the behavior severity of the children in their class per incident.

Another limitation was obvious during the study. The sample size was small and segregated into one elementary single elementary school in Joplin, Missouri. In order for the results of this study to be generalized, further research with a variety of populations and population sizes is warranted. The standard deviation was another issue since the sample was taken from a wide range of grades, grades one through five. Had the researcher focused on just first through third grade students, the variance in scores could have been reduced due to more similar results.

The results from this study coincide with the existing literature review because it marries well with the premise of additional recess in terms of offering a solidified physical activity mechanism to help improve children’s academic performance and classroom behavior. It also confirms that there can be improvement in auditory memory, reading levels, and behavior with increased amounts of sensory stimulation through physical activity. The teachers associated with the study found the implementation of the maze to be an easy addition to their regular daily routine and felt as though the twenty-minutes per day was worthwhile. Based on the Maze approach and Minds in Motion premises (Meyer, 2012), during the 20-minute structured time split between the maze and station activities, the teachers (a) identified and shared the purpose of
the activities with the children, (b) demonstrated the tasks, (c) used language specifically related
to the children’s movement literacy, (d) monitored children’s performances, and (e) provided
feedback. Adjusting tasks to the level of the children’s development and allowing children to
make adaptations was not taken into consideration.

Conclusions

The purpose of this study was to determine the effects of the Minds in Motion maze on
first through fifth grade students. The maze involved an intervention group participating in 15
movement activities each day for twenty minutes, ten minutes in the morning and ten minutes in
the afternoon. The control group remained in their typical daily activities. The findings suggest
that although there was no significance found in auditory memory and reading levels, there could
have still improvement in both areas. Also the increase in poor classroom behavior could have
been improved had another, more objective behavior assessment been used.

While the data suggests that the Minds in Motion maze would not significantly benefit a
participant’s auditory memory, reading levels, and classroom behavior, further statistical
evidence could contradict these statistical findings. Further exploratory data analysis
investigating the means in the testing scores (posttest minus pretest), indicate that improvements
were taking place in the auditory memory and reading levels for both the intervention and
control groups, although not significantly.

The comments made by some of the teachers during the post study meeting attest to the
fact that some teachers saw improvement in behavior and felt as though the intervention did not
have any negative effects on the students, as some of the results would indicate. They further
expressed their desire to continue doing the maze for a longer time period, especially in
preparation for MAP testing. All of these points, along with information found in the literature
review, point to the fact that the maze can have a positive effect on auditory memory, reading levels, and classroom behavior. A larger sample size or continuing beyond the 6-week intervention, could have produced significance in the study.

**Implications and Recommendations**

The implications and recommendations presented in this study are discussed in the following sections: implications for practice, implications for theory, and recommendations for future research.

**Implications for practice.** With no data driven evidence to what effect the Minds in Motion maze has on the auditory memory, reading level, and classroom behavior of first through fifth grade students, there are no direct implications found from this study. While the direct implications were not present by the statistical analysis, there is much indirect evidence of the benefit of the Minds in Motion maze. The exploratory review of the mean (posttest minus pretest) suggests improvements occurred in the auditory memory and reading levels. The opinions expressed (see Meeting Notes) by the teachers suggest that the maze was a noteworthy part of their daily schedule and that they would like to continue to use it in the future. This further suggests that the maze could be a viable activity for all elementary schools to consider implementing into their daily schedule.

**Implications for theory.** As stated earlier, research is proving that mental processes involve both sides of the brain and the integration problems between the two hemispheres can result in inefficient brain functioning. Thus, some children have reading problems, central auditory processing disorders, language delays, and other learning problems that can be associated with poor academic achievement and classroom behavior. The Minds in Motion maze
addresses these issues through a series of movement stations that focus on sensory integration, namely vestibular stimulation. Focusing on balance to address academic achievement and classroom behavior can help lessen such problems.

**Recommendations for future research.** It is recommended that future studies be conducted to investigate the effect that the Minds in Motion maze has on auditory memory, reading level, and classroom behavior. Considering there is a minimal amount of research on the effect of the maze, further research needs to be done in this area. One suggestion would be to concentrate on one area of assessment. Choosing to focus on auditory memory, reading level, or classroom behavior would have focused the study on one factor rather than three. Also, the results of the study indicate that the 6-week intervention needed to be extended to the entire 12-week Minds in Motion curriculum program. Future research needs to investigate what would be an “ideal” length of time for students to demonstrate significant improvements in the three factors evaluated in this study.

**Summary**

In conclusion, the purpose of this study was to investigate the effect of the Minds in Motion maze on the auditory memory, reading level, and classroom behavior of first through fifth grade students. This was accomplished by using two sample populations that consisted of a control group and an intervention group who participated in 20-minutes of sensory stimulation physical activity each day during a 6-week study. While the data did not support a significance in the effect of the maze, other indirect findings suggest that the maze could improve all three of these areas. This study illustrates that additional activity outside of recess and physical
education could have a lasting and powerful impact on academic achievement and classroom behavior of elementary students.

The national recommendation for schools is to have a comprehensive approach for addressing physical education and physical activity in schools known as the Comprehensive School Physical Activity Program. The Center of Disease Control and SHAPE America have developed a how-to guide of incorporating the recommended 60-minutes per day into the lives of elementary children. It includes Physical Education and family and community engagement. This study indicates that The Minds in Motion maze could have a place in the three other prongs of the program: staff involvement, physical activity during school, and physical activity before and after school as key components to the program.
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Sensory Integration. Marie Di Matties.


APPENDICES

Appendix A: Institutional Review Board Approval Letter

To: Maryann Mitts
From: Douglas James Adams, Chair
IRB Committee
Date: 03/21/2018
Action: Expedited Approval
Action Date: 03/21/2018
Protocol #: 180196662
Study Title: EFFECT OF SENSORY STIMULATION IN PHYSICAL ACTIVITY ON ACADEMIC ACHIEVEMENT AND CLASSROOM BEHAVIOR IN ELEMENTARY STUDENTS
Expiration Date: 02/19/2019
Last Approval Date:

The above-referenced protocol has been approved following expedited review by the IRB Committee that oversees research with human subjects.

If the research involves collaboration with another institution then the research cannot commence until the Committee receives written notification of approval from the collaborating institution’s IRB.

It is the Principal Investigator’s responsibility to obtain review and continued approval before the expiration date.

Protocols are approved for a maximum period of one year. You may not continue any research activity beyond the expiration date without Committee approval. Please submit continuation requests early enough to allow sufficient time for review. Failure to receive approval for continuation before the expiration date will result in the automatic suspension of the approval of this protocol. Information collected following suspension is unapproved research and cannot be reported or published as research data. If you do not wish continued approval, please notify the Committee of the study closure.

Adverse Events: Any serious or unexpected adverse event must be reported to the IRB Committee within 48 hours. All other adverse events should be reported within 10 working days.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, study personnel, or number of participants, please submit an amendment to the IRB. All changes must be approved by the IRB Committee before they can be initiated.

You must maintain a research file for at least 3 years after completion of the study. This file should include all correspondence with the IRB Committee, original signed consent forms, and study data.

cc: Dean Richard Gorman, Key Personnel
    Cathy D Lirgg, Key Personnel
Appendix B: Consent for a Minor to Participate in a Research Study

EFFECT OF SENSORY STIMULATION IN PHYSICAL ACTIVITY ON ACADEMIC ACHIEVEMENT AND CLASSROOM BEHAVIOR IN ELEMENTARY STUDENTS
Consent for a Minor to Participate in a Research Study
Principle Researcher: Maryann Mitts
Faculty Advisor: Dr. Dean Gorman

This is a parental permission form for research participation. It contains important information about this study and expectations if you permit your child to participate.

Your child’s participation is voluntary. Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to permit your child to participate. If you permit your child to participate, you are asked to sign this form and will receive a copy of the form. We must also have your child’s assent to participate in this study.

INVITATION TO PARTICIPATE
Your child is invited to participate in a research study about the effects of sensory stimulation in physical activity on memory, reading scores, and behavior. Your child is being asked to participate in this study because the elementary students (grades 1-5) in your child’s school have been selected to participate in this study.

WHAT YOU SHOULD KNOW ABOUT THE RESEARCH STUDY

Who is the Principle Researcher?
Maryann Mitts

Who is the Faculty Advisor?
Dr. Dean Gorman

What is the purpose of this research study?
The purpose of this study is to investigate the effect of sensory stimulation in physical activity on the reading capabilities, memory (retention of information), and behavior of elementary students (grades 1-5) in a Joplin, Missouri elementary school. To measure reading capability, the district uses the Developmental Reading Assessment (DRA) that is a tool to identify a student’s reading level, accuracy, fluency, and comprehension. Memory will be measured using an Auditory Digit Span Assessment. Students will listen to a series of numbers starting with two digits, then three digits, while working towards the highest level of competency (7-digits). Students will be measured by the number of correct responses (responses in which the numbers were repeated correctly and in the sequencing order). Finally, behavior will be measured through Office Referrals, visits to the principal’s office for advanced poor behavior.

Who will participate in this study?
The first through fifth grade classes in your school have been selected to serve as participants in this study. Throughout the normal school day, one class from each of the previously mentioned grades will serve as the control group ($n = 94$). The other class from the previously mentioned grades will be the intervention group: participating in a vestibular stimulation maze twice a day (once in the morning and once in the afternoon) for ten (10) minutes ($n = 91$).

For purposes of this study, students in the control group will not have access to the vestibular stimulation maze at any time during the six-week study. However, upon completion of this study, those students who did not get an opportunity to participate in the maze will have an opportunity to participate led by first-grade teacher Sandie Rhoades (or their classroom teacher).

**What will your child be asked to do?**
Your child’s participation will require the following:

Your child will take part in an 6-week study. Week 1, your child will be involved in a pretest consisting of the Auditory Digit Span Assessment to measure memory. The results of your child’s Developmental Reading Assessment (DRA), given by your child’s classroom teacher, will be used for the study as well as your child’s principal’s records of office referrals. The behavior report will include all documentation six weeks prior to the initiation of the study until the pretest week and during the six week intervention period. Week 2-7, your child’s teacher will conduct two (2) ten-minute sessions, one in the morning and one in the afternoon, where your child will perform a series of fifteen (15) different activities requiring basic balance and coordination. Week 6, similar to week 1, an Auditory Span Assessment posttest will be administered to measure memory, the Developmental Reading Assessment (DRA) will be administered, and the office referral report (during the time your child participated in the vestibular stimulation intervention maze study) will be reviewed as well.

Once again, after the study is completed, those students who did not have an opportunity to participate (control group) in the vestibular stimulation maze will be given an opportunity to do so led by first-grade teacher (or their classroom teacher). Those students, who participated in the maze, will return to their “regularly” scheduled curriculum.

**What are the possible risks or discomforts?**
As with any physical activity or series of movements, there are some risks involved. These risks could include the following: sore muscles, fatigue, mild dizziness, and injuries sustained from falls. To reduce these risks, all children are monitored closely, protective mats will line the floor, spacing between stations and amongst children will be enforced, and proper mechanics will be taught to students to increase the likelihood that the activities will be performed properly.

**What are the possible benefits to your child if he/she participates in this study?**
By participating in a sensory stimulation maze, your child may potentially increase their memory, classroom behavior, and reading level.

**How long will the study last?**
Students will participate in the vestibular stimulation maze during the normally scheduled school day. The specific time of each morning and afternoon session are predetermined by your child’s
teacher, but will remain at that time consistently throughout the 6-week period. Students will participate in each sensory stimulation maze sessions for ten (10) minutes.

**Will your child receive compensation for time and inconvenience if you choose to allow him/her to participate in this study?**
Your child will not receive any compensation for participating in this study. However, those students who did not have an opportunity to participate in the sensory stimulation maze during the study will have the opportunity to do so after the study. First-grade teacher, Sandie Rhoades (or your child’s classroom teacher) will create these scenarios to ensure that every child has an opportunity to enjoy this activity.

**Will you or your child have to pay for anything?**
No, there will be no cost for participation in this study. This study is supported by Elementary School in supplying all the necessary equipment at no cost to the participant.

**What are the options if I do not want my child to be in the study?**
Participation in the study is completely voluntary. If you do not want your child to be in this study, you may refuse to allow him/her to participate. Your child may refuse to participate even if you give permission. If your child decides to participate and then changes his/her mind, your child may quit participating at any time. You may end your participation at any time by telling your child’s teacher, the principal or the principle researcher. Participation, non-participation, or ending your participation will not affect your child’s grade in any way. Your child will not be punished or discriminated against in any way if you refuse to allow participation or if your child chooses not to participate in this study.

**How will my child’s confidentiality be protected?**
All information will be kept confidential to the extent allowed by applicable State and Federal law and University policy. Each student will be assigned a unique identification number for coding purposes and data analysis with all personal information removed. Your child’s Principal and his/her teacher, along with the Principle Researcher, Maryann Mitts, will assist in data collection (pretest and posttest fitness tests) and your child’s teacher will conduct the daily maze activities. However, they will not have access to the data once the data is being prepared for analysis. Since the school district uses the DRA test as part of the annual testing protocol, the participants pretest scores will be used for the districts reading testing during the semester. All data collected for the MAZE study will be kept in a password protected computer.

**Will my child and/or I know the results of the study?**
At the conclusion of the study you will have the right to request feedback about the results. You may contact the faculty advisor, Dr. Dean Gorman or Principle Researcher, Maryann Mitts at

**What do I do if I have questions about the research study?**
You have the right to contact the Principle Researcher or Faculty Advisor as listed below for any concerns that you may have.
Principle Researcher’s name and contact information:
Maryann Mitts

Faculty Advisor’s name and contact information:
Dr. Dean Gorman

You may also contact the University of Arkansas Research Compliance office listed below if you have questions about your rights as a participant, or to discuss any concerns about, or problems with the research.

Ro Windwalker, CIP
Institutional Review Board Coordinator
Research Compliance
University of Arkansas
109 MLKG Building
Fayetteville, AR  72701-1201

I have read the above statement and have been able to ask questions and express concerns, which have been satisfactorily responded to by the investigator. I understand the purpose of the study as well as the potential benefits and risks that are involved. I understand that participation is voluntary. I understand that significant new findings developed during this research will be shared with me and, as appropriate, my child. I understand that no rights have been waived by signing the consent form. I have been given a copy of the consent form.

______  ___________________  ___________________
Printed Name of Parent or Guardian  Signature of Parent or Guardian  Date

“I have discussed this with my parent or guardian and I agree to participate.”

______  ___________________  ___________________
Printed Name of Participant  Signature of Participant  Date

IRB #:
Approved:
Expires:
Appendix C: Approval Letter from Research Site

August 8, 2017

Dr. Dean Gorman
Chair – Doctorate Dissertation Committee
(Maryann Mitts)
University of Arkansas

Dear Dr. Gorman,

This letter is to inform you and the University of Arkansas that Maryann Mitts has been provided permission to conduct her dissertation study at Columbia Elementary located in Joplin, Missouri. I have discussed Maryann’s research study with Dr. Stephen Gilbreth, Assistant Superintendent with Joplin Schools and he is aware of the study.

If you have any questions please feel free to contact me at 417-625-5325 or via email at shallylundien@joplinschools.org.

Sincerely,

Shally Lundien
Appendix D: Minds in Motion Copyright Approval Letter

To Whom It May Concern,

Maryann Mitts, PhD student at the University of Arkansas, has total and full permission to use the Minds in Motion maze, curriculum, and other related materials for her vestibular stimulation study and dissertation.

Sincerely,

Candace S. Meyer

Candace Meyer
Founder, Minds in Motion
Appendix E: Auditory Digit Span Assessment

MINDS-IN-MOTION, INC.

AUDITORY DIGIT SPAN ASSESSMENT

WORKING MEMORY is the DRIVER OF COGNITION. Working memory and attention are cofactors in the learning process. (Jie Huang, J. and Sekuler, R. (2010) and Zanto, T. and Gazzaley, A. (2009)

Say numbers in monotone voice... slowly... in one second intervals. Have student repeat them. Determine student's highest numerical digit span by starting with a 2 digit, then a 3 digit, and working up to the highest level of competency.

<table>
<thead>
<tr>
<th>2 DIGIT</th>
<th>3 DIGIT</th>
<th>4 DIGIT</th>
<th>5 DIGIT</th>
<th>6 DIGIT</th>
<th>7 DIGIT</th>
</tr>
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<tbody>
<tr>
<td>1-6</td>
<td>2-4-1</td>
<td>9-4-2-9</td>
<td>3-9-2-1-4</td>
<td>5-2-1-6-9-2</td>
<td>3-9-2-1-4-2-8</td>
</tr>
<tr>
<td>2-9</td>
<td>5-2-8</td>
<td>6-3-1-8</td>
<td>8-9-6-4-5</td>
<td>6-9-3-8-9-4</td>
<td>8-1-6-4-5-8-4</td>
</tr>
<tr>
<td>8-3</td>
<td>9-3-6</td>
<td>5-2-3-1</td>
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<td>3-2-9-1-5-6</td>
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</tr>
<tr>
<td>9-5</td>
<td>6-1-9</td>
<td>6-4-9-2</td>
<td>6-3-3-4-2</td>
<td>8-6-2-4-5-9</td>
<td>6-8-3-2-4-1-9</td>
</tr>
<tr>
<td>2-6</td>
<td>4-8-3</td>
<td>1-3-4-8</td>
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<td>2-5-6-1</td>
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<td>4-1-9-4</td>
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<td>9-8-4-2-6-3</td>
<td>4-5-8-2-5-1-3</td>
</tr>
</tbody>
</table>

Pre-assessment ___________ ___________ ___________
Date Score Age

Post-assessment ___________ ___________ ___________
Date Score Age

Scoring notes: Start with the easiest column and say all the numbers in the column as per the instructions. Then move to the harder column. Circle the ones he/she gets correct allowing for three mistakes. Then count the number of completed columns and then the number of correct answers in the columns with misses (or mistakes) For Example: If Tommy gets all of Column 3 correct, and gets 6 right in the next column, then his score is 3.6.

(compiled by Minds-in-Motion, Inc.; based upon protocols by Dr. Robert Doman)
Reprinted with permission from Minds in Motion. Copyright 2013 by Candace Meyer.

Auditory Digit Span Instructions:

This test should be done in a seated position with a distance of 3-4’ between child and instructor.
Tell the child:

“The computer is going to read some numbers. When the computer gets done saying them I want you to repeat them to me in the exact same order.” (For younger children, you may have to practice with giving out some numbers and getting them to respond.). We are going to start with two numbers and then move to three, four, etc.

The computer reads the first two numbers. If the student gets it correct, move to the next number. Proceed through the numbers until the student says the number sequence incorrectly three times. If at any time, the student becomes stressed or anxious, please stop the test immediately.

SCORING:

Count the number of lines that the student repeated correctly. The student must repeat all number in the line correctly for the line to be correct. Allow for three “misses”. Count the correct number of line responses that are correct (not including the three misses). Report the number of correct lines for data collection.

Example: The computer asks Johnny to repeat twenty (20) lines of numbers. He repeats all twenty lines, doing so incorrectly three (3) times. Johnny’s score would be 17.
## Appendix F: Developmental Reading Assessment (DRA) Scoring Grid

<table>
<thead>
<tr>
<th>DRA 2 Stage</th>
<th>DRA 2 Level</th>
<th>Name</th>
</tr>
</thead>
<tbody>
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<td>Third Grade</td>
<td>40</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Advanced Independent Instruction</td>
</tr>
<tr>
<td>Grade</td>
<td>Kindergarten</td>
<td>First</td>
</tr>
<tr>
<td>-------</td>
<td>--------------</td>
<td>-------</td>
</tr>
<tr>
<td>Emergent Kindergarten</td>
<td>3</td>
<td>Independent Developing</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Independent Developing</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Developing</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>Developing</td>
</tr>
</tbody>
</table>

**Advanced**: Total score for Oral Reading Fluency and Comprehension must be within the Advanced range on the Continuum.

**Independent**: Total score for Oral Reading Fluency and Comprehension must be at least within the Independent range on the Continuum.

**Instructional**: Total score for either Oral Reading Fluency or Comprehension is within the Instructional range on the Continuum.
Appendix G: Think Sheet

**SHEET**

Name __________________________________  Date__________________________

Did you follow directions? Yes _____ No _____

What did you do? _________________________________________________________
________________________________________________________________________
________________________________________________________________________

What did you want? (put a check next to the appropriate statement)

_____ Did you want attention?

_____ Did you want to be in charge?

_____ Did you want to avoid working?

_____ Did you want to cause problems because you felt sad?

_____ Did you do the behavior because you think they don’t like you?

_____ I wanted ________________________________

Did you get what you wanted? Yes _____ No _____

What could you do differently? _____________________________________________
________________________________________________________________________
________________________________________________________________________

Can you go back to class and behave? Yes _____ No _____

Student Signature: ________________________  Teacher Signature: ________________
## Appendix H: Office Referral Sheet

### OFFICE REFERRAL

<table>
<thead>
<tr>
<th>Student:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade:</td>
<td></td>
</tr>
<tr>
<td>K 1 2 3 4 5</td>
<td>Time of Behavior:</td>
</tr>
<tr>
<td>Referred By:</td>
<td>Classroom Teacher:</td>
</tr>
<tr>
<td>Location:</td>
<td></td>
</tr>
<tr>
<td>Classroom</td>
<td>Gym</td>
</tr>
<tr>
<td>Cafeteria</td>
<td>Bus</td>
</tr>
<tr>
<td>Actions Taken Prior To Referral:</td>
<td></td>
</tr>
<tr>
<td>Teacher Managed Behavior</td>
<td>Reflection Sheet</td>
</tr>
<tr>
<td>Parent Conference</td>
<td>Principal Behavior Meeting</td>
</tr>
<tr>
<td>Possible Motivation:</td>
<td></td>
</tr>
<tr>
<td>Peer Attention</td>
<td>Adult Attention</td>
</tr>
<tr>
<td>Other/Explain:</td>
<td></td>
</tr>
<tr>
<td>Reason for Referral (choose one):</td>
<td></td>
</tr>
<tr>
<td>Disruption</td>
<td>Physical contact (push/shove)</td>
</tr>
<tr>
<td>Verbal Threat</td>
<td>Danger to Self/Others</td>
</tr>
<tr>
<td>Weapon</td>
<td>Defiance/Disrespect</td>
</tr>
<tr>
<td>Explain:</td>
<td></td>
</tr>
<tr>
<td>Discipline Assigned:</td>
<td></td>
</tr>
<tr>
<td>Conference w/Student</td>
<td>Lunch Detention</td>
</tr>
<tr>
<td>Counselor Conference</td>
<td>Loss of Privilege</td>
</tr>
<tr>
<td>OSS _______ Days</td>
<td></td>
</tr>
<tr>
<td>Explain:</td>
<td></td>
</tr>
<tr>
<td>Teacher Signature:</td>
<td>Student Signature:</td>
</tr>
<tr>
<td>Principal Signature:</td>
<td>Parent Signature:</td>
</tr>
</tbody>
</table>
Appendix I: Equipment List

Balance Beams
- Use at least 2 boards of varying thickness
- 1” x 4” x 12’ (or whatever length your space can accommodate)
- 2” x 4” x 12’
- 4” x 4” x 12’
- 3’ x 4” x 12’ (you can use duct tape to tape a 1 x 4 and 2 x 4 together if a 3 x 4 board is hard to attain)

Bean Bags (5-6 Dozen)
- Use varying sizes and weights
- Vary the contents between sand, beans, rice, popcorn, or gravel

Balance Boards (5-6 Individual Boards)
- Approximately 12” x 22” each
- A variety of balance boards work well: wooden, hard plastic, wobble boards, adjustable rockers

Eye Tracking Pencils/Wands (4-6 Pencils)
- Pencil toppers can change by the season (apples, ghosts, Easter eggs, etc.)

Items for Climbing Over
- Wooden steps or varying heights
- Cardboard building blocks
- Cones and cross-bars, etc.

Pads to Stomp On
- Carpet Squares
- Foam Interlocking Squares
- Cushioned Floor Tiles that Stick to the Floor

Tumbling Mats
- 2 (4’ x 8’) mats hooked together work well

Vision Bead Strings
- (8-9 strings mounted on a 1” x 2” x 8’)

Miscellaneous
- Containers to keep beanbags, pencils, etc. (MIM, 2012)

Appendix J: Minds in Motion Maze (Hallway)

Minds in Motion Maze

6. Strong Arm Push
5. Eye can Converge
4. Electric Slide
3. Puppy Dog Crawls
2. Monster Mash
1. Eye to Eye
14. Skip to my Lou
13. Crosswalk
15. Step Back – completed on stairs
9. Jelly Rolls
10. Climb Every Mountain
11. Bean Bag Boogie
12. Jumping Jack Flash
## Appendix K: Minds in Motion Maze Curriculum

### Minds - In – Motion WEEK 1

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SKIP TO MY LOU</strong></td>
<td>Skip along designated “path” while arms are swinging cross-laterally while pumping arms</td>
</tr>
<tr>
<td><strong>ELECTRIC SLIDE</strong></td>
<td>Side step along a designated wall keeping eyes, face, feet and whole body facing forward, but moving sideways by taking a step to the side, then sliding the following foot along until it touches the lead foot. Halfway through the path, turn 180 degrees and continue on, leading with the other foot. Get as close to the wall as possible without touching it.</td>
</tr>
<tr>
<td><strong>BEAN BAG BOOGIE</strong></td>
<td>Throw and catch a bean bag starting with a 2-hand catch and always following the bag with your eyes, while always moving along the circuit. Progress through several skill levels of throwing and catching in subsequent weeks.</td>
</tr>
<tr>
<td><strong>EYE TO EYE</strong></td>
<td>One student stands in front of student and moves pencil slowly (with bright topper or eraser) in front of the student’s eyes (approximately 14 inches away) while the student follows the object with his/her eyes. The pencil should be moved in the following pattern: 2 horizontal, 2 vertical, 2 circles clockwise, 2 circles counterclockwise, 2 moving in towards nose.</td>
</tr>
<tr>
<td><strong>JUMPING JACK FLASH</strong></td>
<td>Do a standing “broad jump” between two designated lines drawn or taped on the floor.</td>
</tr>
<tr>
<td><strong>JELLY ROLL</strong></td>
<td>Roll on a mat on the floor in a predetermined manner.</td>
</tr>
<tr>
<td><strong>CROSS WALK</strong></td>
<td>Slowly walk a given distance lifting knees high while touching alternating knee with opposite hand while other arm is held to the side.</td>
</tr>
<tr>
<td><strong>BALANCE BOARD BASH</strong></td>
<td>Stand on a wooden balance boards training the body to suspend in balance.</td>
</tr>
<tr>
<td><strong>CLIMB EVERY MOUNTAIN</strong></td>
<td>Step over hurdles or obstacles of varying heights.</td>
</tr>
<tr>
<td><strong>BEAM TEAM</strong></td>
<td>Walk on long wooden boards in a variety of manners to develop balance. Always turn around at midpoint; continue by walking backwards.</td>
</tr>
<tr>
<td><strong>MONSTER MASH</strong></td>
<td>Stomp down hard on padded shapes or blocks laid out on floor in a pattern.</td>
</tr>
<tr>
<td><strong>PUPPY DOG CRAWL</strong></td>
<td>Crawl on hands and knees down on the floor in a given direction for a specified distance.</td>
</tr>
<tr>
<td><strong>EYE CAN CONVERGENCE</strong></td>
<td>Hold “Eye Beads” (3 beads affixed to a 4 foot string) in your hand and focus on each differently colored bead one at a time while counting to 10 for each bead. For younger students, have them say the color of the bead, instead of counting.</td>
</tr>
<tr>
<td><strong>STRONG ARM PUSH</strong></td>
<td>Standing facing a wall, then push against the wall with the palms of the hands. Try pushing with as much force as possible for a count of ten.</td>
</tr>
<tr>
<td><strong>STEP BACK</strong></td>
<td>Walk “backwards” up a set of stairs holding onto a rail for support.</td>
</tr>
<tr>
<td>Exercise</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SKIP TO MY LOU</td>
<td></td>
</tr>
<tr>
<td>ELECTRIC SLIDE</td>
<td></td>
</tr>
<tr>
<td>BEAN BAG BOOGIE</td>
<td>Throw a bean bag up in the air and try to touch it (NOT kick it) with RIGHT foot when it comes down. Do this 10 times while moving along the path.</td>
</tr>
<tr>
<td>EYE TO EYE</td>
<td></td>
</tr>
<tr>
<td>JUMPING JACK FLASH</td>
<td></td>
</tr>
<tr>
<td>JELLY ROLL</td>
<td></td>
</tr>
<tr>
<td>CROSS WALK</td>
<td></td>
</tr>
<tr>
<td>BALANCE BOARD BASH</td>
<td></td>
</tr>
<tr>
<td>CLIMB EVERY MOUNTAIN</td>
<td></td>
</tr>
<tr>
<td>BEAM TEAM</td>
<td>Holding your arms straight out to each side, walk down the beam turning backward at midpoint, while keeping your eyes on the fixation point (Black X on wall)</td>
</tr>
<tr>
<td>MONSTER MASH</td>
<td></td>
</tr>
<tr>
<td>PUPPY DOG CRAWL</td>
<td></td>
</tr>
<tr>
<td>EYE CAN CONVERGENCE</td>
<td></td>
</tr>
<tr>
<td>STRONG ARM PUSH</td>
<td></td>
</tr>
<tr>
<td>STEP BACK</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SKIP TO MY LOU</td>
<td></td>
</tr>
<tr>
<td>ELECTRIC SLIDE</td>
<td></td>
</tr>
<tr>
<td><strong>BEAN BAG BOOGIE</strong></td>
<td>Throw a bean bag up in the air and try to touch it (NOT kick it) with LEFT foot when it comes down. Do this 10 times while moving along the path.</td>
</tr>
<tr>
<td>EYE TO EYE</td>
<td></td>
</tr>
<tr>
<td>JUMPING JACK FLASH</td>
<td></td>
</tr>
<tr>
<td><strong>JELLY ROLL</strong></td>
<td>Roll with your head at opposite side of the mat from last week.</td>
</tr>
<tr>
<td>CROSS WALK</td>
<td></td>
</tr>
<tr>
<td>BALANCE BOARD BASH</td>
<td></td>
</tr>
<tr>
<td>CLIMB EVERY MOUNTAIN</td>
<td></td>
</tr>
<tr>
<td><strong>BEAM TEAM</strong></td>
<td>Holding your LEFT arm extended out level with your shoulder, walk down the beam.</td>
</tr>
<tr>
<td>MONSTER MASH</td>
<td></td>
</tr>
<tr>
<td>PUPPY DOG CRAWL</td>
<td></td>
</tr>
<tr>
<td>EYE CAN CONVERGENCE</td>
<td></td>
</tr>
<tr>
<td>STRONG ARM PUSH</td>
<td></td>
</tr>
<tr>
<td>STEP BACK</td>
<td></td>
</tr>
<tr>
<td>Exercise</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SKIP TO MY LOU</td>
<td></td>
</tr>
<tr>
<td>ELECTRIC SLIDE</td>
<td></td>
</tr>
<tr>
<td>BEAN BAG BOOGIE</td>
<td>Throw a beanbag up in the air. Say “right”, or “left” or say “both”. Then</td>
</tr>
<tr>
<td></td>
<td>catch with your right hand, the left hand, or both hands. Follow your</td>
</tr>
<tr>
<td></td>
<td>command</td>
</tr>
<tr>
<td>EYE TO EYE</td>
<td></td>
</tr>
<tr>
<td>JUMPING JACK FLASH</td>
<td></td>
</tr>
<tr>
<td>JELLY ROLL</td>
<td>Roll with your head at opposite side of the mat from last week.</td>
</tr>
<tr>
<td>CROSS WALK</td>
<td></td>
</tr>
<tr>
<td>BALANCE BOARD BASH</td>
<td></td>
</tr>
<tr>
<td>CLIMB EVERY MOUNTAIN</td>
<td></td>
</tr>
<tr>
<td>BEAM TEAM</td>
<td>Holding your RIGHT arm extended out level with your shoulder, walk down the</td>
</tr>
<tr>
<td></td>
<td>beam.</td>
</tr>
<tr>
<td>MONSTER MASH</td>
<td></td>
</tr>
<tr>
<td>PUPPY DOG CRAWL</td>
<td></td>
</tr>
<tr>
<td>EYE CAN CONVERGENCE</td>
<td></td>
</tr>
<tr>
<td>STRONG ARM PUSH</td>
<td>Push wall with RIGHT hip</td>
</tr>
<tr>
<td>STEP BACK</td>
<td></td>
</tr>
<tr>
<td><strong>Minds - In – Motion WEEK 5</strong></td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>SKIP TO MY LOU</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ELECTRIC SLIDE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BEAN BAG BOOGIE</strong></td>
<td>Throw a beanbag up in the air. When it reaches the top of its trajectory, close your eyes and try to catch it with your eyes closed. Repeat 10 times.</td>
</tr>
<tr>
<td><strong>EYE TO EYE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>JUMPING JACK FLASH</strong></td>
<td></td>
</tr>
<tr>
<td><strong>JELLY ROLL</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CROSS WALK</strong></td>
<td>Take turns touching each elbow to the opposite knee as you cross walk.</td>
</tr>
<tr>
<td><strong>BALANCE BOARD BASH</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CLIMB EVERY MOUNTAIN</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BEAM TEAM</strong></td>
<td>Hold both arms out to the side of the body, level with shoulders. Hold palms up while walking on the beam.</td>
</tr>
<tr>
<td><strong>MONSTER MASH</strong></td>
<td></td>
</tr>
<tr>
<td><strong>PUPPY DOG CRAWL</strong></td>
<td></td>
</tr>
<tr>
<td><strong>EYE CAN CONVERGENCE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>STRONG ARM PUSH</strong></td>
<td>Push wall with LEFT hip</td>
</tr>
<tr>
<td><strong>STEP BACK</strong></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>SKIP TO MY LOU</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ELECTRIC SLIDE</strong></td>
<td>While sliding, clap hands twice about your head, then clap twice low behind your back.</td>
</tr>
<tr>
<td><strong>BEAN BAG BOOGIE</strong></td>
<td>Take 2 bean bags and throw them in rhythmic sequence. For example: Left hand – 2 times; right hand – 1 time. Continue at least 10 times.</td>
</tr>
<tr>
<td><strong>EYE TO EYE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>JUMPING JACK FLASH</strong></td>
<td></td>
</tr>
<tr>
<td><strong>JELLY ROLL</strong></td>
<td></td>
</tr>
<tr>
<td><strong>CROSS WALK</strong></td>
<td></td>
</tr>
<tr>
<td><strong>BALANCE BOARD BASH</strong></td>
<td>While balancing, clap hands twice above your head, then clap twice low behind your back, keep repeating while counting to 10.</td>
</tr>
<tr>
<td><strong>CLIMB EVERY MOUNTAIN</strong></td>
<td>New items to climb over! (Reconfigure hurdles or get new items for the students to step over).</td>
</tr>
<tr>
<td><strong>BEAM TEAM</strong></td>
<td>Hold your arms out in front of you. Hold your palms down while walking forward on the beams (like Frankenstein).</td>
</tr>
<tr>
<td><strong>MONSTER MASH</strong></td>
<td></td>
</tr>
<tr>
<td><strong>PUPPY DOG CRAWL</strong></td>
<td></td>
</tr>
<tr>
<td><strong>EYE CAN CONVERGENCE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>STRONG ARM PUSH</strong></td>
<td></td>
</tr>
<tr>
<td><strong>STEP BACK</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Appendix L: Daily Maze Schedule**

The following represents the schedule given to all intervention classroom teachers. It signifies the two 10-minute sessions, one scheduled in the morning and one scheduled in the afternoon. Such a schedule improves consistency enabling the study’s results to be more reliable and valid.

<table>
<thead>
<tr>
<th>Time</th>
<th>Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM</td>
<td>Rhoades</td>
</tr>
<tr>
<td>8:05 AM</td>
<td>Rhoades</td>
</tr>
<tr>
<td>8:20 AM</td>
<td>Johnson</td>
</tr>
<tr>
<td>8:25 AM</td>
<td>Johnson</td>
</tr>
<tr>
<td>8:40 AM</td>
<td>Stehm</td>
</tr>
<tr>
<td>8:45 AM</td>
<td>Stehm</td>
</tr>
<tr>
<td>9:30 AM</td>
<td>Allen</td>
</tr>
<tr>
<td>11:30 AM</td>
<td>Williams</td>
</tr>
<tr>
<td>12:40 PM</td>
<td>Johnson</td>
</tr>
<tr>
<td>12:45 PM</td>
<td>Johnson</td>
</tr>
<tr>
<td>12:55 PM</td>
<td>Stehm</td>
</tr>
<tr>
<td>1:00 PM</td>
<td>Stehm</td>
</tr>
<tr>
<td>1:25 PM</td>
<td>Williams</td>
</tr>
<tr>
<td>1:40 PM</td>
<td>Rhoades</td>
</tr>
<tr>
<td>1:45 PM</td>
<td>Rhoades</td>
</tr>
<tr>
<td>1:50 PM</td>
<td>Allen</td>
</tr>
</tbody>
</table>
Appendix M: Daily Recording Form

The following form by each intervention classroom teacher. This recording form will ensure accountability in terms of sessions attended by each individual student over the six-week intervention period.

<table>
<thead>
<tr>
<th>Name</th>
<th>DATE AM</th>
<th>DATE AM</th>
<th>DATE PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Doe</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Teacher: Mary Smith
Week Number: 4

INTERVENTION or CONTROL (circle one)
Appendix N: Minds in Motion Study Disclaimer

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