2019

Movement Opportunities Through Vestibular Engagement To Rhythm (mover)

Lindsay B. Williams
Eastern Kentucky University, lindsay_williams174@mymail.eku.edu

MOVEMENT OPPORTUNITIES THROUGH VESTIBULAR ENGAGEMENT TO RHYTHM (MOVER)

Presented in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Occupational Therapy

Eastern Kentucky University

College of Health Sciences

Department of Occupational Science and Occupational Therapy

Lindsay Williams, MS, OTR/L, MT-BC

2019

EASTERN KENTUCKY UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

This project, written by Lindsay Williams under direction of Camille Skubik-Peplaski, Faculty Mentor, and approved by members of the project committee, has been presented and accepted in partial fulfillment of requirements for the degree of

DOCTOR OF OCCUPATIONAL THERAPY

CAPSTONE COMMITTEE

Camille Skubik-Peplaski — 5/8/2019

Faculty Mentor — Date

Jennifer Light OTD, OTR/L — May 8, 2019

Committee Member — Date

EASTERN KENTUCKY UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENTOF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

Certification

We hereby certify that this Capstone project, submitted by Lindsay Williams, conforms to acceptable standards and is fully adequate in scope and quality to fulfill the project requirement for the Doctor of Occupational Therapy degree.

Approved:

Dana Howell 5/17/19

Dana Howell, PhD, OTD, OTR/L Date

Program Coordinator, Doctor of Occupational Therapy

Colleen Schneck 5/17/19

Colleen Schneck, ScD, OTR/L, FAOTA Date

Chair, Department of Occupational Science and Occupational Therapy

Executive Summary

Background: Across the United States, school systems have decreased the amount of proprioceptive activities and vestibular-based movement opportunities within the school day to focus on academic skills and test score improvement (Centers for Disease Control and Prevention, 2010). Stemming from this curriculum modification, children's free play and movement opportunities are being replaced by more sedentary experiences such as structured academic activities and screen time. As a result, elementary school students with attention deficits, especially those who have a history of prenatal drug exposure, are not receiving sufficient movement opportunities needed during the day to maximize their attention and to regulate sensory-related behaviors for optimal occupational performance (Pappas, 2011).

Purpose: The purpose of this Capstone project was to investigate the effects of participation in a community-based movement-to music program on the attention span and sensory-related behaviors of elementary school-aged children who have identified attention deficits. The hypothesis was that children who participate in a total of four guided movement-to-music sessions will demonstrate improved attention as tested by the Test of Sustained Selective Attention (TOSSA) (Kovacs, 2015) as well as decreased maladaptive sensory behaviors as reported by caregivers via the Movement Opportunities through Vestibular Engagement to Rhythm (MOVER) Caregiver Survey.

Theoretical Framework: The primary theoretical frameworks that supported the development of this Capstone project were the Person Environment Occupation (PEO) Model (Law et al., 1996) and the Ayres Sensory Integration Framework (Ayres, 1972).

Methods: This quantitative Capstone project involved nine elementary school-aged children who attended four hour-long movement-to-music sessions with a stagger stop within a period of six weeks. The Capstone project incorporated a single group pre-test/post-test design with outcomes measured by the TOSSA and the MOVER Caregiver Survey. A paired samples t-test was performed for the TOSSA subcategories of concentration strength, detection strength, response inhibition strength, and total test-taking time tolerance as well as for the MOVER Caregiver Survey total responses. In order to increase the trustworthiness of the results, qualitative data was also collected through peer debriefing and the primary investigator's utilization of field notes and a reflexive journal. Within these documents, the primary investigator recorded observed behaviors, verbalizations, and actions of the participants.

Results: Results from the TOSSA administration data found that participation in a therapist-guided movement-to-music program can significantly improve the attention of children who have attention deficits. Based on the results of the MOVER Caregiver Survey, no significant correlation was found between participation in a group-based movement-to-music program and decreased maladaptive sensory behaviors. Within the qualitative data collection, the primary

investigator observed and recorded improved attention and socialization throughout the research process. The primary investigator recommends future replication studies for validating these findings.

Conclusions: This Capstone project demonstrated positive implications for occupational therapy practice and for both school and statewide policy change regarding the inclusion of vestibular and proprioceptive movement opportunities available for elementary school children, especially those who have attention deficits secondary to Neonatal Abstinence Syndrome (NAS). Therapists working with children who have attention deficits should incorporate vestibular movement and proprioceptive components at the beginning of their sessions in order to promote the optimal attention and behavior needed for occupational performance throughout the session. Therapists should also consider a child's movement opportunities when observing maladaptive sensory behaviors and attention deficits during sessions, seeking to find if movement is beneficial to help with these nonproductive sensory behaviors before assuming the children's problems arise from defiance or lack of interest in instructed tasks.

Acknowledgements

First and foremost, I would like to express my greatest appreciation to Dr. Camille Skubik-Peplaski for her guidance and mentorship throughout the length of this Capstone project from creation to completion. Her inspiration and feedback motivated me to strengthen my skills as a researcher and to challenge myself as a student and occupational therapist.

Advice given by Dr. Jennifer Hight has also been a great help in the editing and finalization of my Capstone report.

I wish to acknowledge the help provided by my four research assistants: Savannah Taylor, Glenna Nave, Kyle Mounger, and Patrick Long. These individuals willingly volunteered their time to assist with the implementation of the MOVER program.

I express sincere gratitude to Angie Odom, the owner of the TLC Community Center, for graciously allowing my MOVER Program to be implemented at her facility at no cost.

My special thanks are also extended to the owners of Winchester Flooring who donated carpet squares for use in the MOVER Program.

I desire to acknowledge my Applied Leadership Experience mentor, Chris McKinney, who provided me with very valuable information from his experience as a Creative Motion instructor which contributed to the creation of the MOVER Program Plan.

I am particularly grateful for the encouragement of my parents and grandparents. Their emotional and financial assistance throughout my degree pursuit has aided in my success in this program.

Finally, this journey would not have been possible without the support of my husband, Gabriel, who has made countless sacrifices to make sure I had the time and resources I needed to complete my assignments. My daughter, Callaway, has also motivated me strive for the highest and to never give up on my dreams.

EASTERN KENTUCKY UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

CERTIFICATION OF AUTHORSHIP

Submitted to Camille Skubik-Peplaski:

Student's Name: Lindsay Williams, MS, OTR/L, MT-BC

Title of Submission: Movement Opportunities through Vestibular Engagement to Rhythm (MOVER): A Therapeutic Movement-to-Music Program for Children with Attention Deficits

Certification of Authorship: I hereby certify that I am the author of this document and that any assistance I received in its preparation is fully acknowledged and disclosed in the document. I have also cited all sources from which I obtained data, ideas, or words that are copied directly or paraphrased in the document. Sources are properly credited according to accepted standards for professional publications. I also certify that this paper was prepared by me for this purpose.

Student's Signature: Lindsay Williams, OTR/L

Date of Submission: 05/08/2019

Table of Contents

List of Tables

List of Figures

Section 1: Nature of Project and Problem Identification

Introduction

This Capstone project was an investigation of the effects of a movement-to-music program for children who have attention deficits and/or maladaptive sensory behaviors identified by their caregivers. Children in Northeast Tennessee were chosen as the target population due to the high number of children who are in low-income families and/or who are exposed to drug use (Health Grove, 2017). The selected region not only has a lack of resources due to its small size and rustic mountain location, but also within the last decade, there was a significant influx of infants diagnosed with Neonatal Abstinence Syndrome (NAS) (Health Grove, 2017). NAS is a medical diagnosis given to babies who are born addicted to drugs and who experience symptoms of withdrawal due to their mother's dependence on medications or illicit substances during pregnancy (United States National Library of Medicine, 2017). The Tennessee Early Intervention System (TEIS) revealed the incidences of NAS among children who receive early intervention services within the region of Northeast Tennessee, stating that out of 320 children who qualified for early intervention, 77 (24%) had NAS diagnoses (Tennessee Department of Education, 2017). The long-term effects of prenatal exposure to drugs include but are not limited to attention deficits, issues with sensory processing, and lack of age-appropriate social skills (Ranger, 2018). Barthel (2017) also found that children who were diagnosed with NAS as infants have continued issues with inattention as well as problems with sensory modulation including (a) an increased need for vestibular and proprioceptive input, (b) the necessity for reduced environmental stimuli for effective learning, and (c) the tendency to become overstimulated (Barthel, 2017).

Problem Statement

Due to the continued rise in the diagnoses of NAS in Northeast Tennessee (Patrick, Davis, Lehmann, & Cooper, 2015) as well as the identified long-term effects of this condition (Wass, Simmons, Thomas, & Riley, 2002), there has been a significant increase in elementary school-aged children with attention deficits and issues with sensory modulation (Tennessee Department of Health, 2015). Unfortunately, across the United States, school systems have decreased the amount of proprioceptive activities and vestibular-based movement opportunities within the school day to focus on academic skills and test score improvement (Centers for Disease Control and Prevention, 2010). This change was made primarily for the purpose of obtaining and/or maintaining the status of National Blue Ribbon School, a nation-wide award label given to disadvantaged schools with high academic performance and achievement (United States Department of Education, 2017). Stemming from this curriculum modification, children's free play and movement opportunities are being replaced by more sedentary activities including structured academic activities and screen time (Pappas, 2011). Ultimately, the problem is that elementary school students with attention deficits, especially those who have a history of prenatal drug exposure, are not receiving opportunities for vestibular and proprioceptive input, outlets for creativity, and movement opportunities needed during the day to maximize their attention for social engagement and for academic performance (Pappas, 2011).

Abbreviated Literature Review

For this Capstone project, the definition of *attention* is a condition of focus and readiness in which a child is able to concentrate on a single stimulus in order to participate in a task until completion (Cherry, 2018). Within this Capstone project, the definition of *maladaptive sensory behavior* is any behavior that is externalized or poorly regulated due to issues with sensory

seeking, a subtype of Sensory Processing Disorder (SPD) (Liu, 2004). These behaviors include the following: a high activity level or excessive energy, impulsivity, a lack of safety awareness, aggressiveness in play, high distractibility, resistance to change, difficulty with transitions, problems with emotional regulation, and a lack of age-appropriate social skills (Schoen, Miller, Brett-Green, & Nielsen, 2009). The definition of *occupational performance* is the ability to appropriately and successfully participate in occupations that are typical for the elementary school-aged pediatric population including socialization with peers and adults, academic work, basic self-care, involvement in community experiences, and play (Dunbar, 1999). For this Capstone project, the definition of *aesthetic(s)* is that which is pleasing to the senses due to appearance or effect (e.g. the human body, a musical piece, an environment perceived as beautiful, etc.) (Aesthetic, n. d.). Within this Capstone project, the definition of *response inhibition* is the ability for individuals to omit or stop behavioral reactions when external stimuli are present (Weinbach, Kalanthroff, Avnit, & Henik, 2015). The definition of *setting* is the location and environment in which a program takes place, and the definition of *treatment* is the set of program activities that are created and instructed by the primary investigator.

Batty et al. (2009) examined the biological differences between the brains of children with attention deficit hyperactivity disorder (ADHD) and children who were considered typically-developing. Through the conduction of structural magnetic resonance imaging sessions, the authors found that not only do children with ADHD have reduced whole brain volume, but they also have lower gray matter in all lobes of the brain and a thinner cortex in the pars opercularis bilaterally. The pars opercularis, a brain region located in the inferior frontal gyrus, plays a key role in response inhibition which explains why these children have impulsivity in addition to attention deficits (Batty et al., 2009). In addition, drug exposure during the

prenatal period has been found to disrupt the monoaminergic function of neurotransmitters within the brain which assist with controlling attention span and focus (Chiriboga, Starr, Kuhn, and Wasserman, 2009). This provides evidence that prenatal drug use (and subsequently NAS) negatively affects attention, activity levels, and processing skills of diagnosed children. Slater and Tate (2018) also found that there is a significant intersection between the neural systems involved in ADHD and those used to process rhythmic stimuli. The activated areas of the brain that perceive complex temporal patterns (e.g. music) are the same areas that control sequencing, time-keeping, and attention (Janata & Grafton, 2003). Furthermore, another study's results show that musical stimuli can activate several emotion-regulating brain components including the amygdala, the prefrontal cortex, the hippocampus, the hypothalamus, and the insular and cingulate cortexes (Boso, Politi, Barale, & Enzo, 2006). Overall, these studies suggest that utilizing music within a therapeutic setting can assist with the management of ADHD. However, the researchers of these studies state that there is still a lack of rigorous studies that support the clinical application of a movement-to-music intervention with this population, indicating the need to confirm these initial findings through future research (Boso et al., 2006).

Cleary (2002) conducted research on the human vestibular system and connected issues with vestibular processing to attention deficits. The author found that sensory input sends sensory impulses into the reticular arousal system (RAS), and when the vestibular system is underactive, the RAS is not stimulated enough to control alertness. This results in a person demonstrating distractibility and hyperactivity (Cleary, 2002). Chasnoff (2014) further described how sensory processing and attention are related, stating that proper sensory modulation assists in the maintenance of attention, of appropriate social interaction, and of perceiving one's surroundings. The author explained why children with sensory processing difficulties (especially

those who demonstrated vestibular-seeking behavior) often receive diagnoses of ADHD when they become school-aged. These children often feel uncomfortable in their own bodies, needing more movement and sensory input in order to feel at ease. Justifying the need for a sensory integration-based therapy program for children who were prenatally exposed to drugs, the author found that all of these factors promote learning, concentration, the development of positive self-esteem, and successful occupational performance (Chasnoff, 2014).

Some researchers have found that the rhythmic and temporal structure of music has positive implications for therapeutic use with individuals who have attention deficits. For example, Manning and Schutz (2013) found that when movement to a rhythmic beat was allowed, movement participants demonstrated improved timekeeping. Grönlund, Renck, and Weibull (2005) found that dance-based intervention can also decrease the behavioral and socio-emotional symptoms of boys between the ages of five and seven years old who have attention deficits. Not only can moving to rhythmic pulses improve timing perception in humans, but also the music itself has several dimensions such as spontaneity, sequentialism, rhythm, and the ability to evoke an emotional response—components that can positively regulate attention. (Luiz & Jorgensen, 2015)

Levin (2018) discovered that the aesthetic nature of dancing helps to increase both attention and behavioral awareness in children who have ADHD. Through observation of children's increased attention to task and decreased externalized behaviors during participation in capoeira, a rhythmic dance that resembles breakdancing, the author found that movement-to-music can transition the movements associated with an attention deficit into a productive form of personal expression. Rickson (2006) provided both instructional and improvisational music

therapy sessions, and the children who participated in the music therapy groups (versus the control group) demonstrated significantly enhanced accuracy on the Synchronized Tapping Task as well as a significant overall reduction in their Conner's' DSM-IV Total and Global Index subscale scores (including restlessness and hyperactivity). Similarly, Kim and Chung (2015) implemented a sensory integration-based therapeutic dance program with children diagnosed with ADHD for eight weeks and found that the children who participated in the vestibular and proprioception-based dance intervention demonstrated decreased hyperactivity, reduced hostility, increased social skills, diminished issues with sensory modulation, and improved concentration.

Bhat and Srinivasan (2013) examined the impact that participation in movement to music has on children with sensory issues secondary to autism. Through reviewing the results of brain-imaging technology, the authors revealed benefits of combining music with a movement component for increasing functional brain activity in children with autism. In comparison to typically-developing children in a control group, children with autism had lower activation in the inferior frontal gyrus (IFG) during speech stimulation; however, the activation of the IFG, which also plays a role in response inhibition and risk aversion, was significantly increased in the children with autism during song stimulation (Lai et al., 2012). A similar study by Freundlich, Pike, and Schwartz (1989) found that children who participated in weekly therapeutic movement-to-music sessions demonstrated improved social skills, decreased sensory-seeking behaviors, and improved self-awareness. The systematic review implemented by De Vries et al. (2015) identified several more articles supporting the utilization of music to improve the social development and cognitive skills of children with autism. Outcomes from these studies showed that music (within the therapeutic context) has several benefits including but not limited to the following: the ability to (a) increase attention, (b) improve social behavior, (c) increase

expressive communication, (d) enhance body awareness, and (e) reduce anxiety. Overall, these studies suggest that interventions which employ movement-to-music with children who have autism are endorsed above other more passive treatment methods; however, they recommend continued research on this topic (Bhat & Srinivasan, 2013).

Three research articles were found regarding the effects of dance participation on the attention of typically-developing elementary school children. Results from a study by Roden et al. (2014) showed that those who participated in the movement-to-music group had significant increases in rhythmic abilities, processing speed, and visual attention over time. Additional questionnaire responses based on the perceptions of the caregivers whose children participated in the study also uncovered that the participating children's social competence was greater and continued to develop/improve with participation in a dancing group (Roden et al., 2014). Another study found that behavior problems were less prevalent in dancing groups versus control groups including the children's ability to internalize problem behaviors including those that were based on sensory processing problems (e.g. inability to sit down, destructive play, seeking or avoiding sensory input, etc.) and those that were not (Lobo & Winsler, 2006). The authors of these articles revealed that participation in group-based movement-to-music has a positive impact on age-appropriate social skill development in young children, and they suggest that involving physical activity such as dancing within a child's school day can improve students' selective attention (Kulinna et al., 2018).

Review of the literature indicates that the utilization of a vestibular and proprioceptive-based movement-to-music program could demonstrate promising results in the promotion of attention, social competence, and self-regulation in children. Current research is limited to

individuals with ADHD and autism, however, individuals with NAS often experience similar challenges with attentional deficits, sensory modulation, and social skills. Thus, current literature suggests that further research is merited in relation to vestibular and proprioceptive interventions for populations with sensory regulation difficulties and attentional issues.

Purpose and Objectives

This Capstone project falls under the quantitative method of research, forming a hypothesis that specifies a relationship among identified variables. The hypothesis was that the children who participated in weekly guided movement-to-music sessions, including both proprioceptive and vestibular components, would demonstrate improved attention as tested by the Test of Sustained Selective Attention (TOSSA) (Kovacs, 2015) as well as decreased maladaptive sensory behaviors as reported by caregivers via the Movement Opportunities through Vestibular Engagement to Rhythm (MOVER) Caregiver Survey. The independent variable, the movement-to-music program created for this Capstone project, is defined as a gross motor and vestibular experience that is set to musical pieces with various rhythmic pulses. The dependent variables are the children's attention span and their ability to regulate maladaptive sensory behaviors. The purpose of this Capstone project was to investigate the effects of participation in a community-based movement-to music program on the attention span and sensory-related behaviors of elementary school-aged children who have identified attention deficits. The Capstone objectives were (1) to find out if there is a correlation between participation in weekly structured movement-to-music sessions and improved attention, and (2) to see if there is a relationship between movement-to-music program participation and decreased maladaptive sensory behaviors in elementary school-aged children.

Theoretical Frameworks

The post-positivist philosophical foundation of research was the world view that shaped the quantitative approach selected for this Capstone project (Creswell, 2014). Within the post-positivist world view, also often called the scientific method, the primary investigator incorporates both empirical observation and measurement in order to identify and evaluate the causes that impact research outcomes (Creswell, 2014). In this case, the attention span and behaviors of children were observed and monitored, and numerical data was collected prior to and after program participation (Creswell, 2014).

The primary theoretical framework that guided the development of this project was the Person-Environment-Occupation (PEO) Model. Within this framework, the best match of an activity and environment to a person's interests, skills, and goals can lead to optimal occupational performance (Law et al., 1996). Within this Capstone project, the person was an elementary school-aged child ("Child") and their various occupational preferences and experiences. This section also included the primary investigator who was the person acting as a catalyst for change through her guidance of the movements to music. In this Capstone project, the occupation was moving in space ("Movement"), and it involved a variety of vestibular motions, proprioceptive components, movement styles/speeds, and tactile experiences with props. The environment was a social group setting with the presence of rhythmic auditory stimuli ("Music/Rhythm"). Within a group atmosphere, typically-developing children more likely to modify their behavior, changing their idiosyncrasies in order to conform to the norms of the group (Cashel, 1994). Also, within a group setting, children receive verbal and nonverbal feedback from peers regarding their behavior and participation (Freundlich, Pike, & Schwartz, 1989).

Ultimately, the three components (child, music/rhythm, and movement) overlap in order to create the optimal attention and behavior needed for successful occupational performance in the community (see Figure 1). The hypothesis was that this overlap region will promote elementary school-aged children's improved attention, development of age-appropriate social skills, and ability to regulate sensory-related behaviors. Within optimal attention and behavior for occupational performance, the children are able to have (a) the attention they need to participate in academic tasks until completion, (b) the social behaviors they need to interact appropriately with peers and adults, and (c) the ability to control problematic sensory behaviors that prevent success in activities of daily living. The combination of movement and music within a group context provides an outlet for children to get feedback on appropriate behaviors (while receiving the vestibular input that they need within a safe environment) and leads to optimal occupational performance (Freundlich, Pike, and Schwartz, 1989).

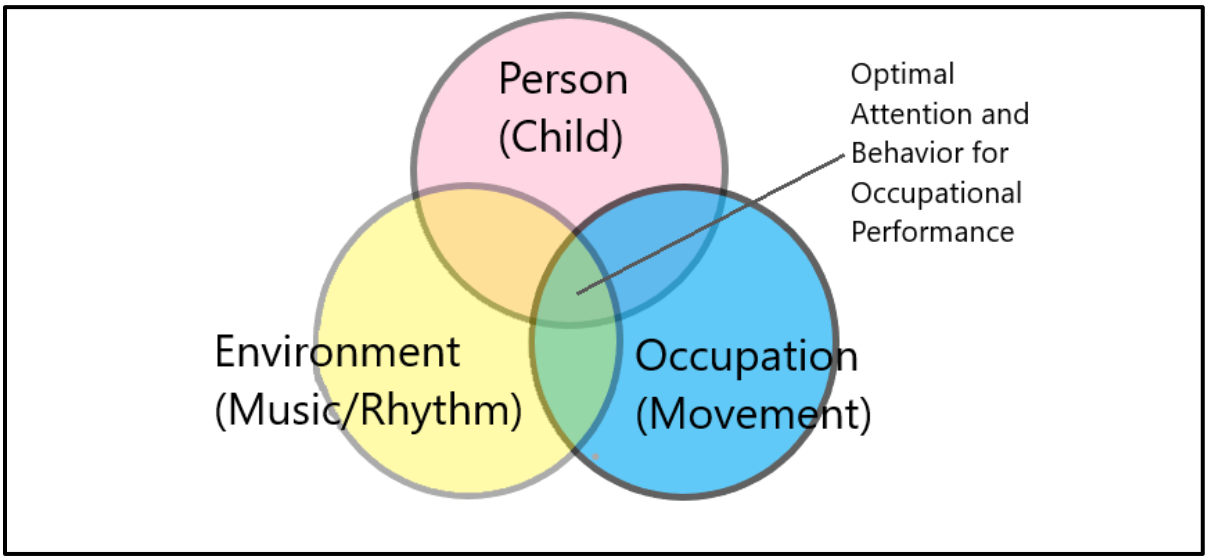


Figure 1. The PEO Model.

Another theoretical model that supported this Capstone project was the Ayres Sensory Integration (ASI) framework. Within this framework, therapeutic techniques aim to impact a child's behavior by providing needed sensations such as vestibular, proprioceptive, or tactile input which promote the child's ability to engage in daily occupational performance (Ayres, 1972). These interventions are focused on regulating behaviors and/or preparing a child for participation in tasks that need undivided attention (Ayres, 1972). Luborsky (2017) found that children who have sensory processing disorder (SPD) are often unable to properly prioritize sensory input which is externalized as inattention. For example, a child who frequently collides with other students in the hallway may have issues with judging where her body is in space due to problems with visual-vestibular integration. Also, a child who appears not to be paying attention to his teacher's lecture may be having difficulty processing auditory stimuli (Luborsky, 2017).

Luborsky (2017) also found that participating in various sensory integrative activities positively modulates attention in these children. Proprioceptive-based movement (compressing joints through weight-bearing and moving musculature against resistance) helps to maintain alertness and facilitates learning in children who have ADHD. Tactile tasks, hands-on experiences that involve the utilization of the hands and feet to feel various textures and objects, can also assist with maintaining a child's attention. Vestibular activities, which involve movements that change the positioning of the head through directional and speed variances, also assist with increasing arousal. Piller (2019) states that 15 minutes of vestibular movement exposure can improve a child's arousal for up to 12 hours. In the MOVER program, the participants were exposed to a variety of proprioceptive, tactile, and vestibular experiences set to rhythmic musical selections. The overlap of the sensory exposure and the rhythmic auditory

stimuli created the superlative scenario for increased attention and decreased maladaptive sensory behaviors for optimal occupational performance (Ayres, 1972).

Significance of the Capstone Project

This Capstone project has clinical implications for the use of movement-to-music intervention with children with attention deficits and/or sensory-related behaviors. The increased frequency of NAS diagnoses and the subsequent late effects of prenatal drug exposure in elementary school children (including issues with attention, emotional regulation, and sensory processing) are negatively affecting schools and pediatric therapy clinics around the nation, impeding therapy progress as well as preventing academic readiness and achievement (Mathias, 1998). Within this Capstone project, not only did all of the children demonstrate significant improvements with attention components including concentration, detection, and total time tolerating the test stimuli, but also several of the participants' caregivers reported seeing positive behavioral changes in their children (including improved sensory modulation and increased age-appropriate social interaction) after participation. Therefore, the primary investigator predicts that the MOVER Program will be useful for occupational therapists to implement as they seek to use creative and multi-faceted occupation-based interventions within pediatric practice settings to increase clients' ability to maintain the attention, self-regulation, and social behaviors needed for occupational performance. It is also predicted this intervention program will be replicated globally in the future with a larger number of children for increased validity.

In conclusion, children are not receiving the movement opportunities needed to adequately maintain attention and behaviors for optimal occupational performance. Evidence has shown the shared neurological basis of movement-to-music and attention and suggests that

the utilization of a therapist-directed, group-based movement-to-music program has the potential to improve self-regulation, attention, and age-appropriate social interactions in elementary school-aged children. Theoretical frameworks including the Person Environment Occupation (PEO) Model and the Ayres Sensory Integration (ASI) Framework have also been found which support the creation and implementation of the MOVER program. These factors, in addition to the results of the Capstone project itself, stress the importance of rhythmic movement as a necessary daily activity with the target population.

Section 2: Detailed Review of the Literature

Background Information

A literature review was conducted utilizing the following databases which were accessed through the Eastern Kentucky University (EKU) Library: EBSCOhost Electronic Journals, EBSCOhost Web, JSTOR, PsycINFO, Cochrane Library, Child Development and Adolescent Studies, Music Index Online, Choice Reviews, Science Direct, MEDLINE, Nursing and Allied Health Database, Project MUSE, and Sage Journals Online. The following search terms were used in various combinations: music, movement, dance, children, the brain, the body, vestibular, ADHD, autism, sensory, pediatric, elementary school, TOSSA, attention, behavior, rhythm, neonatal abstinence syndrome, long-term effects, program, and occupational therapy. Using Firefox as the search engine, articles from the American Occupational Therapy Association (AOTA) and the American Music Therapy Association (AMTA) were retrieved online.

Introduction

The human body naturally moves to rhythmic pulses and music--sometimes uncontrollably. Madison, Gouyon, Ullen, and Hornstrom (2011) labeled this phenomenon with the term *groove*. Groove is further defined as the rhythmic component of music that drives humans to move to the beat. Furthermore, humans can malleably synchronize their movements with sensory input (Iversen & Balasubramaniam, 2016). Wanting to know more about the natural occurrence of moving to music, Madison et al. (2011) investigated how a song's beat and the salience of its rhythmic components correlated with groove. Results determined that both rhythm and beat clarity had strong correlations with groove across all genres of music. This Capstone project showcases how rhythmic music facilitates movement (Madison et al., 2011).

The following review of literature further explains the neurological sources of both attention deficit hyperactivity disorder (ADHD) and dancing as well as provides evidence that relates moving-to-music to improved attention and decreased sensory-related behaviors for optimal occupational performance.

Literature Review

Batty et al. (2009) examined the biological differences in the brains of typical children versus those with ADHD. Through the conduction of structural magnetic resonance imaging sessions, the authors found that not only do children with ADHD have reduced whole brain volume, but they also have lower gray matter in all lobes of the brain and a thinner cortex in the pars opercularis bilaterally. The pars opercularis plays a key role in response inhibition which explains why these children have impulsivity in addition to their attention deficits (Batty et al., 2009). Investigating the relationship between dance observation and neuroplasticity, Karpati, Giacosa, Foster, Penhune, and Hyde (2015) conducted concurrent brain neuroimaging techniques and identified that the participants' pre-motor cortexes and the inferior parietal lobes were activated during their study participants' observation of dancing (Karpati et al., 2015). The premotor cortex houses the pars opercularis as well as part of the inferior frontal gyrus (Brodmann area 44) which is involved in motor sequence learning, motor imagery, and rhythm perception (Limb, 2006). Ono et al. (2014) measured study participants' brain activity while they actively participated in a dance-based video game. Using functional near-infrared spectroscopy, the authors found that the participants showed improved temporal resolution (timing) and decreased motion sensitivity as a result of dance participation (Limb, 2006).

Janata and Grafton (2003) studied the neural substrates that are shared between humans' abilities to process musical stimuli and to sequence body movements within time. The authors found that due to the close connection between perception and action, music provides a clear picture of the neural organization of the complex behaviors that are at the center of human nature. Through reviewing the results of their neuroimaging studies, the authors of this article confirmed that the activated areas of the brain perceived complex informational patterns like music in the same areas that control sequencing, time-keeping, and attention. Therefore, this information biologically supports the utilization of music for improving attention to task and for encouraging movement patterns (Janata & Grafton, 2003). Boso, Politi, Barale, and Enzo (2006) similarly explored the neural comparison of music processing and perception within the human brain. These authors found that musical stimuli activate several emotion-regulating brain components including the amygdala, the prefrontal cortex, the hippocampus, the hypothalamus, and the insular and cingulate cortexes. While this evidence suggests that utilizing music within a therapeutic setting can assist with the management of ADHD, the researchers of this study state that there is still a lack of rigorous studies that support the clinical application of a movement-to-music intervention with this population and indicate the need to confirm their initial findings through further research (Boso et al., 2006).

Slater and Tate (2018) sought to prove that the rhythmic and temporal structure of music has positive implications for therapeutic use with individuals who have attention deficits. The authors highlighted that there is biologically a significant intersection between the neural systems that process musical rhythms and those systems that are implicated in ADHD. A systematic review of literature demonstrated that related individuals with ADHD with issues with timing perception and rhythmic processing in addition to having the traditional symptoms of inattention

and hyperactivity (Hove et al., 2017; Puyjarinet et al., 2017). Other studies in the review revealed that rhythm perception is associated with activation of the brain's auditory cortices and the supplementary motor area (Schroeder et al., 2010; Grahn & Brett, 2007), and this suggests that the close interaction between the sensory and motor regions is necessary for movement synchronization and for temporal prediction and feedback. Ultimately, the authors state that musical experiences requiring rhythmic processing may be valuable within a therapeutic context with children who have ADHD due to the brain areas activated by rhythm, and they suggest further studies to find a potential link between ADHD and the temporal dynamics of the brain (Slater & Tate, 2018).

Luiz and Jorgensen (2015) evaluated the impact that the utilization of music and sound elements have on the timing perception of children who have a diagnosis of ADHD. Participants of this study were 36 elementary and middle school students divided into three groups of 12 students (two groups of children who had ADHD--divided into those who were on medication and who were not--and one control group of children who were without an ADHD diagnosis). All children participated in computer-based tasks that recorded their spontaneous time production, time estimation with simple sound stimuli, and time estimation with music. During the spontaneous time production task, there were no differences among participants, indicating that children who have ADHD do not necessarily have deficits with implicit time function. In the second task, however, the children with ADHD demonstrated lower scores in time estimation with simple sounds. In the third task, time estimation with music, the children with ADHD reported that the songs were longer if they included notes with longer durations, and the children who did not have ADHD reported that the songs with higher instrumental density were longer. This information shows that children with ADHD have a higher attentional demand on counting

auditory occurrences which causes them to perceive increments of time as longer when longer or more frequent sounds are heard. The authors also state that emotions and cognitive perceptions affect temporal processing, and since music evokes affective responses, its presence may improve attention (Luiz and Jorgensen, 2015).

Grönlund, Renck, and Weibull (2005) implemented a ten-week pilot study that focused on the impact of dance therapy on the attention and behavior of elementary-aged boys diagnosed with ADHD. In addition to finding that participation in dance therapy can improve a child's overall motor function, the results from this study found that dance-based intervention can decrease the behavioral and socio-emotional symptoms of boys between the ages of five and seven years old who have attention deficits (Grönlund, Renck, & Weibull, 2005). In a similar study, Levin (2018) discovered the role that the aesthetics of body movement plays in the understanding of attention and behavioral awareness among children diagnosed with ADHD. Within his study, the author observed a group of children diagnosed with ADHD as they participated in the practice of capoeira, an Afro-Brazilian martial art-infused dance that is similar to parkour (street acrobatics) (Kingsford-Smith, 2018). This form of dancing incorporates self-defense movements into a rhythmic dance that resembles breakdancing. Through observation of the children's participation, attention to task, and externalized behavior during capoeira, the author found that capoeira can be considered an aesthetic method of movement that transitions the symptoms of an attention-deficit into a visual form of emotional expression—possibly changing the way society views ADHD (Levin, 2018, p. 149).

De Vries, Beck, Stacey, Winslow, and Meines (2015) conducted a systematic review of literature on music as a therapeutic intervention with children on the Autism Spectrum. Several

articles were found regarding the utilization of music to improve social development and cognitive skills, and outcomes from the studies showed that music within the therapeutic context has several benefits including but not limited to the following: (a) increased attention, (b) improved social behavior, (c) increased expressive communication, (d) enhanced body awareness, and (e) reduced anxiety (De Vries et al., 2015). Furthermore, Manning and Schutz (2013) examined how moving to rhythmic pulses can improve timing perception. Seeking implications for why humans often involuntarily move when music is played, the authors initiated three experiments in which participants listened to equal-timed beats and were asked to report if the closing tone was consistent with the meter and timing of the prior sequence heard. Of the listening segments, half of the trials incorporated tapping along with the rhythm and the other half required the participants to stay still. Results showed that within the trials in which movement to the beat was allowed, participants demonstrated improved timekeeping (Manning & Schutz, 2013). These results were similar to the study by Rickson (2006) who found that children who participated in music-based therapy groups demonstrated significantly-enhanced accuracy on the Synchronized Tapping Task as well as a significant overall reduction in Conner's' DSM-IV Total and Global Index subscale scores (including restlessness and hyperactivity) as reported by their teachers.

Freundlich, Pike, and Schwartz (1989) evaluated a group dance program for children with diagnoses on the Autism Spectrum. Participants were children ages 2-17 with autism and/or sensory processing disorder and their primary caregivers. Dancing movements were prompted to include interaction with others including the caregivers and other kids. At the conclusion of the study, the children who participated demonstrated improved social skills, decreased sensory-seeking behaviors, and improved self-awareness (Freundlich, Pike, & Schwartz, 1989). Within a

similar study, Bhat and Srinivasan (2013) inspected how children with diagnoses on the Autism Spectrum can benefit from participation in dancing to music. The authors stressed the importance of music as a modality with this population due to its ability to improve motor development, communication, and socioemotional skills. Using a brain-imaging technology to study the neurological effects of music and movement on the brain, the authors revealed the ability of the combination of music and movement to increase functional brain activity in children with autism, and they recommend continued research on this topic (Bhat & Srinivasan, 2013).

Lobo and Winsler (2006) examined the impact that dancing has on children's social competence. Within this study, 40 preschoolers in a Head Start class were divided and assigned to either a dance program or a control group. Using the Social Competence Behavior Evaluation (SCBE), teachers and parents rated their children's social skills prior to and after the eight-week study. Results of the questionnaire responses showed that children's social competence was greater and continued to develop/improve with participation in a dancing group. Behavior problems were less prevalent in the dancing group versus the control group including the children's ability to internalize problem behaviors. Overall, the authors related dancing with social aptitude, stating that participation in dance had a positive impact on age-appropriate social skill development in young children (Lobo & Winsler, 2006). Focusing on elementary school-aged children, Kulinna et al. (2018) implemented a quasi-experimental study to analyze the effect of an acute physical education-based dance session on students' selective attention. Participants were divided into a dance group and a comparison group who participated in regular classroom work only. Results from the d2 Test of Attention found that those who participated in the dance group had significantly more improved scores for both total number of test items and

concentration performance. These findings suggest that involving physical activity within a child's school day can improve students' selective attention (Kulinna et al., 2018).

Kovacs (2009), the creator and manual author of the Test of Sustained Selective Attention (TOSSA) compared the d2 Test of Attention to the Wechsler Adult Intelligence Scale-Revised (WAIS-R) Digit Span and to the TOSSA, finding that the TOSSA is the most sensitive test to detect attention deficits. The TOSSA had a detection percentage of 53.1% versus the 44.9% detected by the WAIS-R Digit Span and the 20.4% detected by the d2 Test of Attention (Kovacs, 2009). Onderwater (2004) investigated the convergent validity of the TOSSA by calculating the Spearman's R correlation coefficients among the TOSSA and several other standardized attention tests. Results showed that the following significant correlations were found with the TOSSA: Test of Divided Attention (.45), Stroop Color Word Test (-.51), and the Trail Making Test (-.55). Stutterheim (2006) also found a significant correlation between the TOSSA and the Trail Making Test with (-.53). Searching to find the test-retest reliability of the TOSSA, Onderwater (2004), Stutterheim (2006), and Kovacs (2009) found that the TOSSA has good statistically-significant reliability with individuals who have neurological conditions (see Table 1).

Study	**Concentration Strength**	**Detection Strength**	**Response Inhibition Strength**
Onderwater (2004)	.92	N/A	.86
Stutterheim (2006)	.92	N/A	.82
Kovacs (2009)	.84	.82	.77

Table 1. Reliability scores.

Utilizing the TOSSA with the pediatric population, Kouijzer, de Moor, Gerrits, Congedo, and van Schie (2009) implemented a randomized control trial to see if a neurofeedback training program affected the attention of children diagnosed with autism. Results from the pre-test, post-test TOSSA administration showed significant improvements in the concentration of neurofeedback participants as opposed to no improvement in the control group members (Kouijzer et al., 2009). The TOSSA is an appropriate attention examination for children in this Capstone project for the following reasons: (a) it is one of the shortest of the continuous performance assessments of attention, (b) it does not require visual concentration, and (c) it is easily accessible on a computer (Kovacs, 2018).

Cleary (2002) found a connection between issues with vestibular processing and attention deficits. The author found that sensory input sends sensory impulses into the reticular arousal system (RAS), and when the vestibular system is underactive, the RAS is not stimulated enough to control alertness. This results in a person demonstrating distractibility and hyperactivity (Cleary, 2002). Studying the effects of a sensory integration-based therapeutic dance program on the sensory processing and concentration of children diagnosed with ADHD, Kim and Chung (2015) implemented a quantitative study in which participants' caregivers completed the Short Sensory Profile and an ADHD rating scale before and after an eight-week intervention period. The participating children were divided equally into an experimental group (n=15) and a comparison control group (n=15) with the experimental group participating in a sensory integration-centered therapeutic dance program. Results showed that the children who participated in the dance intervention demonstrated decreased hyperactivity, reduced hostility, increased social skills, diminished issues with sensory modulation, and improved concentration. The results of this study postulate that the utilization of a sensory-focused therapeutic dance

program within an elementary school curriculum would help to improve the overall classroom attention and sensory functioning of children diagnosed with ADHD (Kim & Chung, 2015).

Conclusion

Both rhythm and dance evolve significantly earlier in life than other developmental and musical characteristics (e.g. language, melody, harmony, etc.) (Richter & Ostovar, 2016). Not only are newborns able to perceive and anticipate beats, but infants and toddlers can also spontaneously move with a rhythmic pattern (Richter & Ostovar, 2016). Through this rhythmic movement, children are able to discover how their bodies move and function as well as how they connect to their environment (Dorrat, 2016). Swiss composer and music educator Emile Jacques-Dalcroze created the concept of eurythmics based on this concept, stating that music is best experienced and expressed through body movement (Juntunen, 2016). Eurythmics not only incorporates kinesthetic experiences to music, but its overarching goal focuses on increasing body awareness, communication, social skills, concentration, and attention (Juntunen, 2016).

Children who had prenatal drug exposure have significantly higher incidences of attentional deficits similar to symptoms displayed in populations with ADHD including inattention, impulsiveness, slower reaction time, and hyperactivity (Jaeger et al., 2015). Fortunately, past studies have connected the utilization of movement to music with increased attention and with improved social behaviors, and authors of these studies have suggested that further research be done regarding the therapeutic expediency of dancing by children. Overall, there is promising evidence to support the creation of a movement-to-music program incorporating vestibular and proprioceptive components for children who have attention deficits and/or behaviors stemming from issues with sensory processing, and there is a biological basis

for the use of music to increase attention and improve behavior for optimal occupational performance (Limb, 2006).

Section 3: Methods

Project Design

This Capstone project involved a quantitative, one-group pre-test/post-test design (Creswell, 2014). This design was chosen so that changes that occurred as a result of children's participation in a movement-to-music intervention program could be tracked over four sessions with a staggered stop within a period of six weeks. Within this quasi-experimental design, a single group was observed at two points in time-- one prior to the intervention and one at the conclusion of the intervention. Any changes that occurred are presumed to be a result of the intervention provided (Creswell, 2014). Within this design, no control group was utilized for comparison. Instead, all participants who met the pre-determined inclusion criteria for the program, who gave assent, and whose parents signed the informed consent forms received the therapeutic intervention.

This Capstone was a pilot project, initiating the first time that this program was implemented and examined. Leon, Davis, and Kraemer (2011) defined a pilot study as the first step necessary for the exploration of an original idea or of a new application of an existing intervention, and this Capstone project involved applying a novel movement-to-music intervention with children who have attention deficits and/or issues with maladaptive sensory behaviors that negatively affect their occupational performance. The MOVER Program itself involved several sensory-based movement experiences that were set to a variety of rhythmic musical selections (see Appendix D for example session). Examples of vestibular activities that were implemented within this program include jumping on a trampoline, bouncing on large exercise balls, running, skipping, swaying, swinging arms, mirroring dance movements, and switching directions (e.g. high to low, left to right, forward to backward). Examples of

proprioceptive components were stomping, rolling up in a sleeping bag, using scooter boards, clapping, weightbearing, jumping in and out of hula hoops, and forming yoga poses. The incorporation of tactile input involved the utilization of rhythm sticks, a djembe drum, percussive instruments, and large balls. Various combinations of these sensory experiences were guided by the primary researcher to songs that had consistent, powerful rhythms.

Setting

This Capstone project was implemented in the large open therapy gym area at a public community center in the southeastern United States. This space was selected for several reasons. The community center is centrally located within the rural community in which the participants reside, and it has a treatment space that was the appropriate size for the interventions and for the number of participants in attendance. There were also small quiet rooms that are adjacent to the large gym in which the children could privately take their computerized attention assessments. Not only was the large gym area easily accessible and compliant with building standards set by the American with Disabilities Act (ADA), but it was also safe for children of all ages and abilities/disabilities, having no objects or equipment that could be potential obstacles or hazards (United States Department of Justice, 2018).

Inclusion/Exclusion Criteria

The participants of the Capstone project were elementary school-aged children within a rural county in the southeastern United States who received occupational therapy services and who had difficulty with their attention span and regulation of sensory-related behaviors. Since this Capstone project did not utilize a control group, the sample was selected using non-probability, convenience sampling. This form of sampling involves finding participants who are

easily accessible, who are willing to participate, and who meet certain criteria (Etikan, Musa, & Alkassim, 2016). Therefore, the following inclusion criteria was utilized: (a) Children must be between the ages of 5 years and 10 years old, (b) Children must have attention deficits as identified by their parent, legal guardian/caregiver, and/or teacher, (c) Children must be able to follow single step commands, (d) Children must have hearing within normal limits (for verbal instruction and participation in attention test with auditory component), (e) Children must be able to physically move without equipment or human assistance (wearable devices such as ankle-foot orthotics are allowed as long as the child can freely move in space without assistance from adaptive equipment or another person), (f) Children must be in good general health, (g) Children must already be receiving occupational therapy services, and (h) Both the child and his/her caregiver must cognitively be able to complete assent and informed consent. Exclusion criteria included: (a) children who are younger or older than the specified age range, (b) children who are unable to follow one-step commands, (c) children who have hearing impairments or who are of the Deaf community, and (d) children who do not have identified attention deficits. No child with a particular diagnosis was denied as long as they met the inclusion criteria so that the Capstone project could be more easily generalized to the pediatric population. Participants were recruited through both verbal invitations and with the posting of a promotional flyer that was approved by the Institutional Review Board (IRB) at Eastern Kentucky University.

Project Methods and Outcome Measures

Quantitative data was collected via two methods. First, the attention span of the children was assessed by the Test of Sustained Selective Attention (TOSSA), an eight-minute, computer-based standardized attention examination that requires participants to press the space bar of a computer keyboard when they hear a series of three beeps (Kovacs, 2018). The participants' reactions were

recorded as either correct after three beeps, incorrect after two beeps, or incorrect after four beeps. In this test, pressing the space bar incorrectly is interpreted as being insufficiently focused. The test also identified if the participant failed to react when a series of three beeps passed. This is also interpreted as the participant is not efficiently attentive (Kovacs, 2019). Ultimately, the TOSSA identifies levels of fatigability and mental slowness, the existence of structural and conditional impulsivity, suboptimal effort, and problems with auditory perception which all affect the three tested areas of the assessment: (a) concentration strength, (b) detection strength, and (c) response inhibition (see Appendix B). This test was selected for the following reasons: (a) it is one of the shortest of the continuous performance assessments of attention, (b) it does not require visual concentration, (c) it is easily accessible once purchased and downloaded onto a computer, and (d) it is standardized (Kovacs, 2018). The TOSSA also has sufficient test-retest reliability (.84-.92 range) and convergent validity (.17-.43 range) as shown by previous studies with neurological patients (Onderwater, 2004; Stutterheim, 2006; Kovacs, 2009; Kovacs, 2018). Since both ADHD and Sensory Processing Disorder have neurological foundations (Singer, 2007; Leigh, 2016), this attention examination was appropriate for this Capstone project's target population.

The second quantitative outcome measure was the MOVER Program Caregiver Survey, a primary investigator-created questionnaire that obtained the children's behavioral information through pre-test, post-test reports given by their legal guardians (see Appendix C). This survey included a 5-point rating system in a "circle the correct response" format so that writing was not necessary. Data collected in the questionnaires included sensory behaviors demonstrated, attention deficits noted, and socialization issues identified. The sensory measures for this survey were developed based on Ayres Sensory Integration (ASI) model, with the listed behaviors being consistent with those in the sensory-seeking subcategory of sensory processing. Overall, these

two outcome measures' pre-test and post-test scores were analyzed and compared to find the probability that the movement-to-music program had an effect on the children's attention and sensory-related behaviors (Nelson, Kielhofner, & Taylor, 2017). Since the survey answers were based on the children's current level of functioning, the possibility of the practice effect was eliminated.

Prior to the implementation of the MOVER Program, the primary investigator trained her four research assistants, reviewing the protocol for movement with the target population as well as reviewing assigned roles and responsibilities. Two of the research assistants were occupational therapists who were educated on how to explain and obtain consent through the use of the IRB-approved consent and assent forms created by the primary investigator. The other two research assistants were occupational therapy interns who were educated on how to utilize the TOSSA computer software and who participated in taking the assessment themselves as well as practicing implementation procedures with one another. All four research assistants completed Research Ethics and Compliance Training and were educated on the purpose of the Capstone project, the benefits and potential risks/ethical considerations of the Capstone project, and techniques to utilize for safety, redirection, and behavior management within the MOVER Program sessions.

As for quantitative data analysis strategies, a paired-samples *t*-test was utilized since only one group was followed. This method was chosen because this Capstone project focused on comparing means from the same group at different points in time (Taylor, 2017). The numerical scores in the categories of concentration strength, detection strength, response inhibition, and total number of minutes tolerated from the pre-test and post-test TOSSA administrations were

input into a spreadsheet and compared using a downloaded data analysis package through Microsoft Excel (Microsoft Corporation, 2016). The pre-test and post-test caregiver surveys were also analyzed in this manner. While the individual responses of the caregivers correlated with a number on an ordinal scale (e.g. Likert), the overall total scores of the survey were calculated and compared from the pre-test and post-test administrations with a lower total score signifying less participation in and/or concern for sensory-related behaviors. Changes identified in individual sections of the survey from pre-test to post-test were also analyzed and recorded in a manner similar to other standardized sensory processing-based questionnaires.

For qualitative data analysis, the primary investigator utilized peer debriefing, field notes and a reflexive journal to increase the trustworthiness of the results. The peer debriefing occurred immediately after the conclusion of each movement-to-music session and involved a primary investigator-led discussion regarding the participants' verbal reports of session activities that were favored, fun, simple, complex/difficult, and disliked. After each of the five MOVER sessions, the primary investigator transcribed program field notes, documenting behaviors, verbalizations, and actions she noticed during her participant observation of the children each week. In addition, every evening during the program implementation period, the primary investigator participated in critical self-reflection through reflexive journaling. Within these journal entries, she documented her experiences, thoughts, feelings, and concerns regarding the progress of the participants as well as her leadership skills. The addition of this qualitative data increased the transparency of the research process and heightened the credibility of the results through data triangulation (Ortlipp, 2008).

Prior to the Capstone project's implementation, the primary investigator identified possible threats to validity, with a potential for intervening variables such as the possibility of an increase in movement experiences at the children's homes or schools within the treatment period. The children might have participated in additional fitness or dance experiences outside of the Capstone project that effected the outcomes on their post-test. This could have posed a threat to the internal validity of the Capstone project through a type I error. This type of error involves the reporting a relationship when there is not one (Nelson, Kielhofner, & Taylor, 2017). In order to minimize confounding variables, the primary investigator educated the caregivers, teachers, and therapists of participating children about the Capstone project's purpose and asked them not to vary their children's usual schedules during the time frame of the MOVER Program implementation. The primary investigator encouraged them to continue with their traditional schedules and not to attend other dance experiences while the Capstone project was progressing. A threat to external validity was the potential for attrition. Due to reasons out of the primary investigator's control (illness, bad weather, lack of transportation, forgetfulness, or conflicting commitments), the primary investigator had to understand that participants may not attend one or more of the offered sessions. In an attempt to encourage attendance to the minimum of four sessions required for the utilization of data, the primary investigator sent session reminders via the caregivers' reported preferred method of communication as well as documented reasons for absences when they occurred.

Ethical Considerations

There were also a few potential ethical concerns that were identified prior to the implementation of this Capstone project. The first was the possibility of parent-perceived invasion of privacy regarding the admittance of their child's attention deficits and sensory

behaviors. The primary investigator educated these parents on the rules and regulations outlined by Health Insurance Portability and Accountability Act (HIPAA), verifying that no identifying information about the parents or child participants would be revealed as a result of this Capstone project (United States Department of Health and Human Services, 2003). Also, as with all studies that incorporate clinical intervention, there was a mild to moderate chance of a child sustaining a physical injury. For example, a child could accidentally fall during a movement activity, or a child with a behavioral issue may hit another child during the session. The primary investigator recruited four research assistants who were approved by the Institutional Review Board (IRB) and who agreed to assist within the sessions in order to monitor behavior, to promote safety, and to attempt to prevent injuries from occurring. All of the research assistants were educated on the purpose and outline of the MOVER program prior to implementation, and each research assistant was given specific roles to follow including assisting with the TOSSA and MOVER Caregiver Survey administrations, obtaining consent/assent, providing redirection during transitions, grading movements for each child, and assisting with equipment management. An additional ethical consideration that was made was that no songs with religious affiliations were utilized during the Capstone project. The program was not geared toward a single ethnicity, race, or religion, and children of all cultures were welcome to participate. All ethical considerations and potential risks were outlined in the consent forms, and both the participants and their legal guardians signed assent and informed consent respectively prior to participation in the Capstone project.

Timeline of Project Procedures

In the summer of 2018, the primary investigator started her literature review and the creation of the MOVER program including interventions and musical selections. Two months

later, the primary investigator began her literature consolidation, developed a promotional flyer, and completed her CITI training modules. The primary investigator recruited four research assistants who also completed their CITI training. On December 6, 2018, the primary investigator submitted her expedited IRB, and within the month of December 2018, the primary investigator provided MOVER Program training to her four research assistants.

Recruitment began on January 14, 2019, the date that the Capstone project was officially approved by the IRB. The timeline for the program implementation was originally estimated at 4-5 weeks, however due to unforeseen circumstances, five sessions were held over a period of six weeks with the first session including the collection of information and responses from legal guardians via the written questionnaire and the first administration of the TOSSA. Each week incorporated the primary investigator-led movement-to-music sessions, and each child's fourth session involved the same guardians completing the post-test questionnaires while the children completed their final TOSSA. The data was analyzed after the program's completion and after all data was collected. After data analysis, the primary investigator found literature that supported the results and completed the Capstone report.

Section 4: Results and Discussion

Introduction

Due to the significant increase in diagnoses of NAS in Northeast Tennessee within the last decade (Health Grove, 2017), there has been a rise in elementary school-aged children with attention deficits and issues with sensory modulation (Tennessee Department of Health, 2015). Literature has shown that children who have issues with sensory processing (especially those who were exposed to drugs prenatally) often have problems with attention and sensory-related behaviors due to their need for vestibular and proprioceptive input via body movement (Mullinix, 2013). The purpose of this Capstone project was to investigate if there is a correlation between participation in weekly structured movement-to-music sessions (MOVER Program) and improved attention and/or decreased sensory-related behaviors in elementary school-aged children. For this Capstone project, five movement-to-music sessions were implemented at a local community center, and pre-test/post-test data was collected during each child's first and fourth sessions via the implementation of the Test of Sustained Selective Attention (TOSSA) and the MOVER Caregiver Survey created by the primary investigator. Participants were required to attend at least four sessions in order for their data to be utilized.

Results from the Pre-test/Post-test Measures

Fourteen children signed up for the MOVER Program and Figure 2 shows the attendance total for each of the five sessions of the program. Over a period of six weeks, nine children between the ages of five years and ten years attended and participated in the minimum of four weekly movement-to-music that were needed to be included in the data collection. All of these

participants were children who attended a public elementary school within the county in which the Capstone project was implemented.

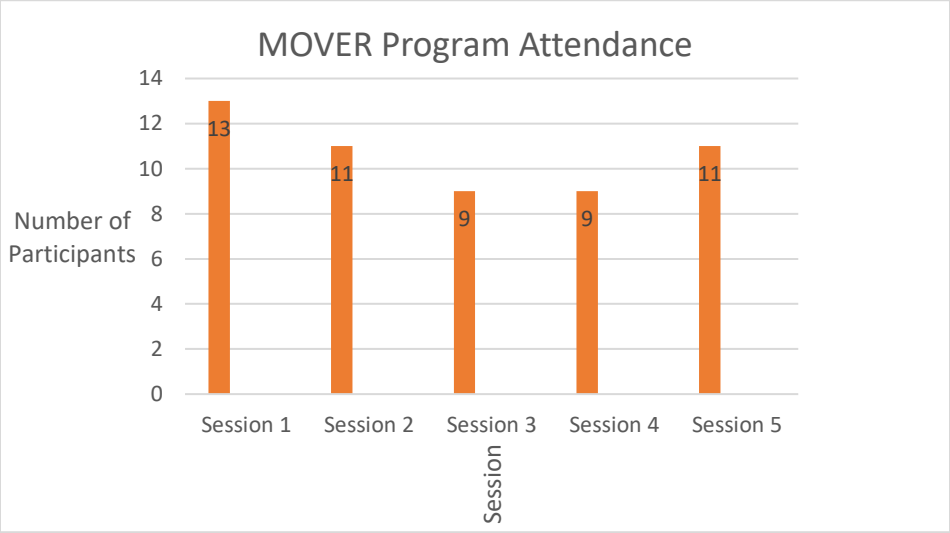


Figure 2. Number of children in attendance each week during the MOVER program.

Four of the nine children had a history of prenatal drug exposure as reported by their legal guardians. Table 2 outlines the number of participants who were exposed each type of drug while in the womb (P= participant). All children were exposed to more than one drug type according to the caregivers' reports in the demographics section of the MOVER Caregiver Survey.

Prescription Medications (non-opioid)	Narcotics	Illicit Substances	Over-the-counter Medications (>29 days of pregnancy)	Caffeine (>300mg daily)	Nicotine	Alcohol
3 (P1, P2)	2 (P2, P9)	2 (P2, P9)	1 (P4)	2 (P1, P4)	1 (P1)	1 (P1)

Table 2. Number of participating children who were prenatally-exposed to various drugs.

Every child had an attention deficit reported by a primary caregiver; however, the primary investigator was unaware of how long each child had a diagnosis with an attention deficit as a symptom (e.g. ADHD, autism, attention deficit disorder without hyperactivity, etc.). Each participant took the TOSSA prior to program participation and at the conclusion of his/her fourth session. Table 3 shows the results of the paired sample t-tests that were run on the data collected from the TOSSA in each of the following categories: Concentration Strength, Detection Strength, Response Inhibition, and Total Time in Test. Numerical scores are shown including the score average (mean) as compared between pretest and posttest, the variance among scores, the Pearson Correlation coefficient, the degrees of freedom, the t-statistic, the P value, and the one-tailed t-test score.

Concentration Strength

	Pre	Post
Mean	13.3	31.711
Variance	187.445	521.80
Pearson Correlation	0.70829	
df	8	
t Stat	-3.38517	
P(T<=t) one-tail	0.00478	
t Critical one-tail	1.85955	

Detection Strength

	Pre	Post
Mean	20.4444	47.3778
Variance	784.053	983.617
Pearson Correlation	0.71577	
df	8	
t Stat	-3.5761	
P(T<=t) one-tail	0.00362	
t Critical one-tail	1.85955	

Response Inhibition

	Pre	Post
Mean	87.6	72.5556
Variance	411.053	432.893
Pearson Correlation	0.69683	
df	8	
t Stat	2.82052	
P(T<=t) one-tail	0.01124	
t Critical one-tail	1.85955	

Total Time in Test (minutes)

	Pre	Post
Mean	3.55556	6.77778
Variance	7.27778	2.69444
Pearson Correlation	0.42655	
df	8	
t Stat	-3.88397	
P(T<=t) one-tail	0.00232	
t Critical one-tail	1.85955	

Table 3. Results from the TOSSA data analysis.

Within the MOVER Caregiver survey (see Appendix C), caregivers rated the frequency of their child's engagement in the listed behaviors as well as their levels of concern for each behavior. Figure 3 reveals the pre-test and post test scores for the MOVER Caregiver Survey for each participant. Series 1 shows the pre-test scores for each child, and Series 2 shows the post-test scores.

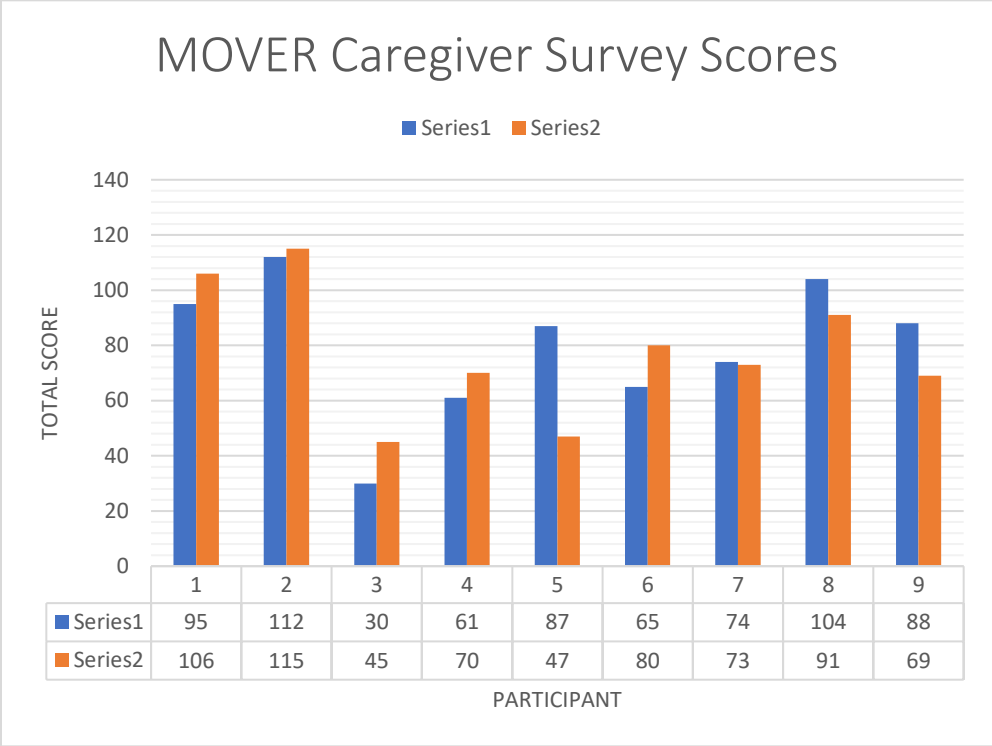


Figure 3. Survey pre-test and post-test scores.

Table 4 shows the results of the paired sample t-test that was utilized to compare the pre-test and the post-test data from the MOVER Caregiver Survey. Numerical scores are shown including the score average (mean), the variance among scores, the Pearson Correlation coefficient, the degrees of freedom, the t-statistic, the P value, and the one-tailed t-test score.

MOVER Caregiver Survey Total Scores

	Pre-test	Post-test
Mean	79.55556	77.33333
Variance	632.2778	567.75
Pearson Correlation	0.714837	
df	8	
t Stat	0.359733	
P(T<=t) one-tail	0.364179	
t Critical one-tail	1.859548	

Table 4. Results of the survey paired sample t-test.

Table 5 gives a visual representation of the behavior frequency ratings given by the participants' caregivers, and Table 6 shows the levels of concern as rated by these caregivers. Within both tables, the symbol "+" signifies the parent's report of increased frequency or concern of behavior, "-" signifies the parent's report of decreased frequency or concern of behavior, and "0" signifies the parent's report that the frequency or concern level of the behavior had not changed from pre-test to post-test.

(P=Participant)	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**#(+)**	**#(-)**
In constant motion (spinning, pacing, rocking, etc.)	0	0	-1	0	-1	+1	-1	-1	0	1/9	4/9
Unable to sit or stay seated	0	0	0	+2	0	+1	0	-1	0	2/9	1/9
Has difficulty maintaining attention on adult-directed activities	-1	0	-2	+1	-1	+1	-2	-1	0	2/9	5/9
Seems uninterested in academic material	0	-1	-3	+2	+1	+1	0	-2	0	3/9	3/9
Engages in socialization with peers that is not age-appropriate	+1	-1	0	+1	0	+1	0	-2	+1	4/9	2/9
Has difficulty following directions	-1	0	-2	+1	0	+2	0	-1	+2	3/9	3/9
Needs several verbal cues to return to tasks in order to complete them	0	+2	-2	+2	0	+2	0	-2	+1	4/9	2/9
Plays briefly with a toy before wanting another	-1	+1	-2	+2	0	+1	+1	0	0	4/9	2/9
Has difficulty with transitions	0	0	-2	0	-2	0	+1	-1	0	1/9	3/9
2acks safety awareness	+1	+1	-2	+1	0	+1	+1	0	0	5/9	1/9

Is impulsive and lacks self-control	-1	+2	-1	+1	+1	+1	0	-1	0	4/9	3/9
Does not interact appropriately with adults	-3	+1	-1	-4	0	+2	+1	0	+1	4/9	3/9
Has difficulty waiting (e.g. in line, for his/her turn, in a waiting area, etc.)	+1	0	-3	+2	+1	0	+1	-2	+2	5/9	2/9
Has tantrums or behavior issues as school	0	+1	0	0	-3	0	+1	-1	0	2/9	2/9
Is easily distracted by auditory and/or visual stimuli	0	0	-2	0	0	+1	0	-2	0	1/9	2/9

Table 5. Caregiver responses to the individual categories of the frequency portion of the survey.

(P=Participant)	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**#(+)**	**#(-)**
In constant motion (spinning, pacing, rocking, etc.)	0	0	0	0	0	0	0	+1	+1	2/9	0/9
Unable to sit or stay seated	0	0	+1	+1	+1	0	0	+1	-1	4/9	1/9
Has difficulty maintaining attention on adult-directed activities	-1	+1	-2	0	0	0	0	0	-1	1/9	3/9
Seems uninterested in academic material	0	+1	-3	+1	+1	0	0	0	0	3/9	1/9
Engages in socialization with peers that is not age-appropriate	+1	+1	0	0	0	0	0	+1	+1	4/9	0/9
Has difficulty following directions	-1	0	-3	0	+1	0	0	-1	+1	2/9	3/9
Needs several verbal cues to return to tasks in order to complete them	0	0	-2	0	0	0	0	0	0	0/9	1/9
Plays briefly with a toy before wanting another	-1	+1	-2	0	0	0	0	+1	+1	3/9	2/9
Has difficulty with transitions	0	+1	-2	-2	+1	0	0	0	-1	2/9	3/9
Lacks safety awareness	0	0	0	0	0	0	0	+2	0	1/9	0/9
Is impulsive and lacks self-control	-1	0	0	+1	+2	0	0	0	+1	3/9	1/9
Does not interact appropriately with adults	-4	0	-1	0	0	0	0	0	+1	1/9	2/9
Has difficulty waiting (e.g. in line, for his/her turn, in a waiting area, etc.)	+1	0	-2	0	+1	0	0	0	-1	2/9	2/9
Has tantrums or behavior issues as school	0	0	0	0	-3	0	0	-1	+1	1/9	2/9
Is easily distracted by auditory and/or visual stimuli	0	0	-1	-1	-1	0	0	0	-1	0/9	4/9

Table 6. Caregiver responses to the individual categories of the concern level portion of the survey.

Results from the Primary Investigator's Observations and Reflexive Journal

Through clinical observation within individual sessions, the primary investigator identified several factors that were observed to increase the attention of the children. Eight out of the nine children demonstrated active attention when it was their turn to select and lead a movement experience during the introduction song each week. This was demonstrated by increased eye contact, the ability to stay in rhythm with the music, matching the primary investigator's movements, and staying in their assigned spots. The ninth child initially withdrew during this activity each week, avoiding eye contact and standing still when it was his turn, however after multiple verbal and visual cues from both the primary investigator and the other children, he actively participated in his own movement and eventually became fully engaged in the intervention. Attention was also increased whenever the primary investigator incorporated a movement to imitate that was perceived as humorous. All nine of the children demonstrated increased attention while the rhythmic music was present versus decreased attention (e.g. reduced eye contact, inability to stay on a carpet square, and initiation of running around the treatment space) in the transitional periods between activities during which the musical stimuli was absent. Within the first two sessions, all nine of the children demonstrated consistently heightened attention to interventions that incorporated props (e.g. balls, rhythm sticks, drum, hula hoops, boomwhackers, etc.) over those that did not involve manipulation of objects in-hand. However, within the third session, the children continued to demonstrate age-appropriate attention to all activities, even with the absence of props. The children demonstrated enhanced attention when the movements incorporated vestibular components such as spinning, head-turning, jumping, and body swinging. Each program meeting ended with a participant debriefing session during which the primary investigator led a discussion about which activities were

considered favorites, which tasks were considered the most difficult, and suggestions for experiences in upcoming weeks. Within these debriefing sessions, the children unanimously reported that they enjoyed the dance mirroring songs just as much as the activities that incorporated hands-on experiences. Dance mirroring songs consisted of the participants' imitating a variety of dance movements performed by the primary investigator who either faced the children or turned her back to the children for increased right-left discrimination. Hands-on experiences involved the utilization of tactile objects such as rhythm sticks, a djembe drum, obstacle course items, boomwhackers, and other forms of equipment.

The primary investigator was familiar with five out of the nine participating children as they were also seen at her employment for intervention (P3, P4, P5, P8, and P9). She was able to identify behaviors that were atypical for these children who were seen in the outpatient setting. For example, P3, who always had excessive energy with constant movement during 1:1 occupational therapy intervention became exhausted during one movement experience of the group program, initiating lying on the floor and stating, "this is hard." Three of the children who were usually seen in the primary investigator's clinic (P4, P8, and P9) stayed on task for longer periods of time and demonstrated improved attention and an increased ability to follow directions in the MOVER Program than in their traditional occupational therapy sessions. This was demonstrated by their ability to mirror the movements made by the primary investigator and to stay involved in each activity without individual redirection and/or cues.

Discussion

Results from paired samples t-tests of each subcategory of the TOSSA showed significant increase in concentration strength, detection strength, and total time tolerated in the attention test

as well as a significant decrease in response inhibition (see Table 3). While only four of the nine participants had a history of NAS, results showed that all four of these children showed significant improvement in concentration strength, detection strength, and total time tolerating the attention examination along with the other participants who did not have a history of prenatal drug exposure. Each of these children also showed a significant decrease in response inhibition which was consistent with the other participants. These results show that children with NAS can benefit from participation in group-based movement-to-music program for increasing their attention.

The group atmosphere could have contributed to the children's increased motivation to participate and to follow directions. While Killen and Tickner (2013) revealed that peer pressure can begin as early as age nine, Welch (2018) found that children as young as five years can care about their reputation, becoming motivated by how others view them. Kindergarteners have been shown to vary their behavior based on who is physically present, often behaving more generously when they realize that they are being watched by others (Welch, 2018). Also, the presence of music within the children's environment most likely played a vital role in their increased attention and participation. The rhythmic patterns in music can increase physical arousal including accelerating breathing and quickening pulse rates as well as elicit socioemotional reactions for mood enhancement (Fenske, 2012). Also, musical selections with strong beats stimulate the brain repetitively and cause impulses in the brain to follow the rhythm, with the quicker beats encouraging increased concentration and alertness (Saarman, 2006). Relating to the Person-Environment-Occupation (PEO) Model, the combination of the vestibular and proprioceptive movements and the group setting with rhythmic auditory stimuli provided an experience that promoted increased attention and involvement for optimal occupational

performance. In relationship to the project outcomes, these results met the first objective with improved attention being a result of MOVER Program participation.

In regard to the lower response inhibition scores of the TOSSA assessment, Scalzo, O'Conner, Orr, Murphy, and Hester (2016) examined the effect of attention diversion on response inhibition, finding that directing one's attention away from an appealing stimulus actually assists with inhibiting impulsive responses. Therefore, since all of the participants' concentration levels increased significantly, it is understandable that their response inhibition scores became lower. With their increased focus on listening to the auditory beeps, the children most likely became hypervigilant, impulsively hitting the space bar too early (Scalzo et al., 2016).

While only four of the nine participants had a history of NAS, results showed that all four of these children showed significant improvement in concentration strength, detection strength, and total time tolerating the attention examination along with the other participants who did not have a history of prenatal drug exposure. Each of these children also showed a significant decrease in response inhibition which was consistent with the other participants. These results show that children with NAS can benefit from participation in group-based movement-to-music program, and the primary investigator recommends that future researchers focus on implementing the MOVER Program with a group of children whose inclusion criteria require a prior diagnosis of NAS or documented history of prenatal drug exposure.

While all participants demonstrated improved overall scores on the TOSSA during the post-test administration, results from the MOVER Caregiver survey were inconsistent and inconclusive, showing no correlation between participation in the MOVER Program and improved sensory-related behaviors (outcome 2). Within the survey, a lower total score indicated

improved behaviors and less concern as reported by the caregivers. When comparing the pre-test and post-test measures for the survey, the primary investigator identified that the levels of concern did not consistently match the behavior frequencies. For example, one parent reported increased frequency of a maladaptive sensory-related behavior in one area but no difference in the corresponding concern level. Other parents reported decreased frequencies of the sensory behaviors but reported increased concern levels for those same areas at post-test. Also, several of the reported behaviors were not demonstrated within the sessions themselves, contrasting with the observations of the primary investigator within the group setting. There are several potential reasons that the survey responses were inconclusive. First, the duration of the program was short, with an implementation period of four weeks between the pre-test and the post-test administrations. The sessions were held one time per week, and there was not a time gap long enough for the participants to sufficiently change long-term behavior issues. Also, one parent filled out her survey two days late and had more time to think about her responses. This, in addition to the possibility that the first survey's implementation could have heightened the parents' awareness of certain behaviors was a limitation to the Capstone project. Second, Hoskin (2012) found that individuals who fill out a questionnaire can often have a response bias, tending to respond in a certain manner regardless of their current situation. Therefore, the parents could have responded based on how the child had been in the past instead of how they were currently functioning. Also, there was also most likely the test-retest effect in which taking the pre-test triggered the caregivers to be more cognizant of the behaviors themselves, therefore reporting a higher frequency during the post-test. One of the parents who filled out the survey for both of her sons may have been impacted by a rating effect in which she gave her lower-functioning

child a lower score than his brother, not due to participation in the MOVER Program, but simply in comparison to his sibling.

Unfortunately, there is also the possibility that any of the parents were managing his/her image as the parent of a disabled child (whether for public perception and/or for financial support). Therefore, the primary investigator was vulnerable to the honesty of the parents, having to assume that the caregivers filling out the survey were truthful in their answers. Guo (2014) found that in order to receive Social Security Income, one must not only prove that they do not have sufficient household income but that they or their child has a disability. Linebaugh (2019) states that adults and children who receive federal income through the Social Security Administration must go through Continuing Disability Reviews (CDR) every three years, and if a child has had significant medical improvement and/or if the child has been marked by a medical professional as no longer "severe" in regard to functional limitations, his/her benefits may be discontinued. Even though the primary investigator explained to all caregivers that the data would be deidentified, parents may be fearful to rate their children too high on a self-report measure such as the MOVER Caregiver Survey (Hoskin, 2012). Another potential reason that the surveys did not yield significant results could be that the parents had varying levels of understanding in regard to the meanings of the questions and/or interpreted the questions differently. While the primary investigator made every attempt to avoid professional lingo, there could have been concepts or phrases that the caregivers did not fully comprehend. The primary researcher ran The Simple Measure of Gobbledygook (SMOG) Index and the Flesch-Kincaid Grade Level Readability Formula, and both literacy rating tests found that the MOVER Caregiver Survey was suitable for readers at or above a ninth-grade reading level (My Byline Media, 2019). The primary investigator is unaware of the educational levels of the caregivers

who took this survey, and the literacy ratings could indicate a lack of understanding by those who do not read at a minimum of a ninth-grade level. Ultimately, the MOVER Caregiver Survey was developed by the primary investigator and was piloted in this Capstone project, having no previous validity or reliability identified.

Qualitative results collected from the field notes, reflexive journal, and peer debriefing showed that the participants were able to demonstrate improved attention and behavior within the overlap of the PEO Model components. For example, within the rhythmic, group-based atmosphere, all children actively participated in each movement intervention without individual redirective cues needed for song completion. The primary investigator observed active engagement of the participants including sustained eye contact, movements correctly mirroring the primary investigator, the children remaining on their assigned carpet squares, and their ability to move in time with the rhythmic pulse. During the vestibular and proprioceptive movement experiences which were based on the Ayers Sensory Integration Framework, the children demonstrated improved age-appropriate social skills and behaviors including the ability to take turns, to copy other participant's movements, to follow adult directions, and to both transition to/from and terminate various activities without demonstrating anxiety or issues with maladaptive sensory behaviors. The children appeared to have the maximal attention when participating in vestibular and proprioceptive activities such as bouncing on large exercise balls, jumping on the trampoline, rolling up in the sleeping bag, and mirroring animal yoga poses. Not only did the children demonstrate increased attention and improved social behaviors during song selections that had strong rhythmic beats, but also the children demonstrated optimal participation during tasks that incorporated tactile input via props (e.g. utilizing rhythm sticks and boomwhacker tubes which were played along with the rhythms themselves). These findings

are consistent with the results of a study by Lockhart (2017) who found that rhythmic auditory stimuli and proprioceptive input are both processed in the cerebellum, and both forms of input impact attention and self-regulation. Once again confirming the effectiveness of the PEO Model, Lockhart (2017) found that the combination of proprioception through body movement (occupation) and rhythmic auditory input (environment) further enhances neural activity in the cerebellum, optimizing outcomes relating to behavior, attention, and sensory integration functioning.

Strengths

One strength of this Capstone is that it is easy to replicate, with the MOVER program having a detailed plan with time frames, musical selections, equipment needs, and movement details that could easily be repeated (see Appendix D.). Another strength was the triangulation of the data through quantitative measures (TOSSA administration and MOVER Caregiver Survey), field notes, the primary investigator's reflexive journal, and peer debriefing. Through triangulation, the primary investigator was better able to understand the results and to validate the findings through converging information from all of these sources (Hales, Peersman, Rugg, & Kiwango, 2010).

An additional strength in this Capstone project was the inclusion of a participant debriefing session as the conclusion of each MOVER Program meeting. It revealed that some children preferred one activity and/or musical selection over another, and they were encouraged to discuss their preferences during the post-session debriefing at each meeting. The children participated in an active discussion of what their favorite interventions were as well as the reasoning behind their decisions. This debriefing session was a time in which the primary investigator could gather supporting qualitative information to modify future sessions to

incorporate preferred activities/experiences. It was also a time when the children could explore and learn about their preferred movement choices and how to generalize them for other environments.

Limitations

The primary limitation of this Capstone project was the primary investigator's course schedule, requiring the MOVER program to be implemented during the winter season. In addition, the program's time frame fell between January and February, East Tennessee's peak influenza season (Nelson, 2018). During the second, third, and fourth weeks of the program, there were children absent from the sessions due to illness. The original date of the fourth session was even cancelled due to the closing of the host facility after a local influenza outbreak closed down three regional school systems. The parents of eight of the participants had contacted the primary investigator and facility host regarding their children having flu-related symptoms, stating that they would not be present that week. Flexibility in the schedule was provided to accommodate for the possibility that one session was missed due to sickness, transportation difficulties, forgetfulness, or weather-related issues. Another scheduling limitation was the time of day in which the program had to be implemented in order for working caregivers to bring children and for the primary investigator to continue working her full-time job. The sessions began at approximately 5:00 p.m. which is a common meal time. However, to accommodate a dinner time session, light food was provided at the beginning of each session to support participation.

An outcome measure limitation was the TOSSA's 8-minute time limit for test-taking tolerance. While the short time frame of the test was a favorable aspect in the selection of this assessment tool for usage in this Capstone project, the inability for a participant to attempt taking

the test for a longer period limited the ability for the children to improve in that category. For example, if a child was able to tolerate taking the test for eight consecutive minutes without quitting, then he/she could possibly improve their score in the post-test administration. Luckily, all participants either improved in their timing or stayed at the 8-minute mark.

Another perceived limitation was the lack of a control group for a true experimental design. Within this Capstone project, convenience sampling was utilized due to the increased amount of children within the primary investigator's outpatient clinic who met the inclusion criteria as well as due to timing and funds, While the Capstone project would have been strengthened if there had been a control group of children who had not received the therapeutic movement-to-music intervention, this was a pilot project that investigated the impact of a newly-created program, and it was the most appropriate to test the same group at two separate times in order to see if the program impacted the participants' attention and/or behavior. Also, Schwartz, Chesney, Irvine, and Keefe (1997) explain that in the realm of clinical research, asking participants to avoid a resource or intervention that has been well-documented as health-enhancing can be both inappropriate and unethical.

Implications for Practice

The results of this Capstone project have several implications for occupational therapy service delivery in both school-based and outpatient pediatric settings. As demonstrated in this project, therapists working with children who have attention deficits should incorporate proprioception, vestibular movement, and tactile experiences at the beginning of their sessions in order to promote the optimal attention and behavior needed for occupational performance. Therapists should also consider a child's movement opportunities when observing maladaptive sensory behaviors and attention deficits during sessions. Therapists should attempt to find if

movement is beneficial to help with these nonproductive sensory behaviors before assuming the children's problems arise from defiance or lack of interest in instructed tasks. This Capstone project also provides positive implications for the utilization of group intervention within community-based occupational therapy practice and suggests that groups may also be effective within the school-based setting.

In regard to policy, the results of this Capstone project justify the requirement for more proprioceptive and vestibular experiences within children's daily routine, especially for those children who have attention deficits. The Tennessee State Board of Education (2005) espouses that elementary school students in Tennessee must have a minimum of 130 minutes of physical activity within each five-day week of school in addition to their allotted physical education class. This amounts to approximately 26 minutes of movement per day. Furthermore, the United States government states that elementary school children need at least 60 minutes per day of physical activity in order to decrease instances of childhood obesity; however, Strauss (2016) found that more movement is necessary for developmental, behavioral, and emotional development. Without adequate "wiggle time," children often initiate movement and behaviors that cause them to be misdiagnosed with ADHD (Strauss, 2016). The author encourages parents and teachers to ensure that children spend at least three hours per day participating in gross motor and vestibular tasks, preferably outdoors (Strauss, 2016). Perhaps, the results of the MOVER Capstone project could contribute to increased movement times during the day for elementary school-aged children. The results of this Capstone project may possibly convince teachers and school administrators to identify the importance for more frequent movement opportunities outside of recess and scheduled physical education, especially for children who have attention deficits and sensory behaviors. These movement breaks could be placed in a child's individualized education

plan (IEP) in order to promote increased attention and improved sensory behaviors for occupational performance within the academic environment.

In addition to the quantitative data collected, the primary investigator identified several qualitative concepts of interest regarding the participation and behaviors of children who attended the MOVER program. For example, due to the participants' caregivers reporting issues with attention and sensory-related behaviors (which was part of the inclusion criteria), the primary investigator had initially expected the children to be inattentive and to have difficulty following directions within the dance space; however, all children participated in each session with seemingly minimal distractibility. This is most likely due to the optimal overlap of the PEO Model in which the children (person) were participating in therapist-guided, sensory-based movement experiences (occupation) to rhythmic auditory stimuli within a group context (environment). Not only were the children seemingly driven to participate by the rhythmic pulse of the music, but the group setting and the vestibular and proprioceptive components of the movements motivated the children to participate until song completion. This implies that with proper opportunities for movement within an engaging atmosphere, these children can attend and learn.

An implication for both occupational therapy practice and for school-based intervention identified from this Capstone project is the utilization of rhythmic music as a motivating stimulus for participation in tasks. Results from the primary investigator's observations showed that the children lost attention during the transitions between interventions which were the only times of the session during which the music was not playing. As soon as the music returned, the children were once again actively participating without verbal redirective cues needed. The music itself acted as a form a redirection. From this concept, perhaps therapists and teachers should consider

utilizing rhythm/music during prolonged tasks or during activity transitions in order to maintain children's interest and attention.

Future Research

While the results of this Capstone project show that there is a correlation between participation in a weekly therapist-guided movement-to-music program and elementary school-age children's improved attention, future research is necessary to further validate sensory-related behaviors could be affected by program participation. In future studies, several possible directions or program adaptations could be considered. First, the project could simply be repeated. Within a replication of this Capstone project, crucial program and outcome measure modifications could also be made to gather more vital research information. Another recommendation for future research would be the inclusion of more total participants (involving a larger number of children by broadening the recruitment area). This increased sample size would strengthen the outcome of this Capstone project. Other possibilities for future studies could include: (a) increasing the frequency of sessions within the same time frame (e.g. two or three times per week), (b) recruiting participants who are older (e.g. adolescents/young adults), and/or (c) extending the duration of sessions (e.g. eight weeks instead of four). Future research based on the MOVER Program could also involve requiring the inclusion criteria involve a history of NAS or documented prenatal drug exposure. This could increase the generalizability of this Capstone project to this specific growing population. Future researchers would need to consider the season in which their study would occur, avoiding the winter months in order to decrease chances of illness and inclement weather affecting attendance.

Summary

This Capstone project sought to find a correlation between elementary school-aged children's participation in a researcher-directed, group-based movement-to-music program and their increased attention as well as decreased maladaptive sensory-related behaviors. The results found a significant correlation between participation in the MOVER program and improved attention (outcome 1). All nine participants demonstrated improved scores in concentration strength and detection strength, and all of the children who did not complete the entire time frame of the pre-test (eight minutes) tolerated longer test times during the post-test.

While results did not show a significant relationship between MOVER program participation and decreased maladaptive sensory behaviors (outcome 2), the primary investigator was able to confirm the efficacy of the PEO model. The primary investigator observed that the children (person) demonstrated improved social behaviors during the proprioceptive and vestibular-based movement interventions (occupation) which were experienced within a group-based setting combined with a rhythmic musical stimulus (environment). Within these conditions, the children were able to actively participate in each intervention until completion without individual redirection, to copy the movements of the primary investigator as instructed and demonstrated, and to remain engaged in adult-directed activities without getting hurt, quitting, or demonstrating an externalized maladaptive sensory behavior. The participants were able to be involved in an activity that was a novelty experience for them and were able to interact with similar-aged peers in a safe and appropriate manner. Overall, the results of this Capstone project show that the overlap of the three sections of the modified PEO Model can improve attention for optimal occupational performance.

In conclusion, the primary investigator has experienced the vulnerability of conducting research itself, having no control over the attendance, participation, and behavior of the Capstone project participants. Through carrying out the implementation of this project, the primary investigator has learned that her facilitation of vestibular movement to rhythmic stimuli can improve the attention of children with attention deficits, further proving that the overlap of the modified PEO Model can promote the necessary attention needed for enhanced occupational performance. She has learned how to look through the eyes of a researcher, focusing more on leading the group and less on individual redirection. Her ability to focus only on her research objectives and to set aside other therapeutic outcomes has developed, as well. Hassan, Schattner, and Mazza (2006) explain that pilot projects, whether they show significant results or not, are essential in laying the groundwork for future research. Not only has the primary investigator of this Capstone project identified her own strengths and weaknesses as a novice researcher conducting a pilot program, but she has also realized that the process of research is even more important than the product.

References

Aesthetic. (n. d.). In *Merriam-Webster.com*. Retrieved from https://www.merriam-webster.com/dictionary/aesthetic

Ayres, A. J. (1972). Improving academic scores through sensory integration. *Journal of Learning Disabilities, 5*(6), 338-343. doi:10.1177/002221947200500605

Barthel, K. (2017). Neonatal abstinence syndrome. Retrieved August 28, 2017, from http://kimbarthel.ca/neonatal-abstinence-syndrome/

Batty, M. J., Liddle, E. B., Pitiot, A., Toro, R., Groom, M. J., Scerif, G., Liotti, M., Liddle, P. F., Paus, T., & Hollis, C. (2009). Cortical gray matter in attention-deficit/hyperactivity disorder: A structural magnetic resonance imaging study. *Journal of the American Academy of Child and Adolescent Psychiatry*, *49*(3), 229-238.

Bhat, A. N., & Srinivasan, S. M. (2013). A review of music and movement therapies for children with autism: Embodied interventions for multisystem development. *Frontiers in Integrative Neuroscience*, (MAR). doi:10.3389/fnint.2013.00022

Boso, M., Politi, P., Barale, F., & Enzo, E. (2006). Neurophysiology and neurobiology of the musical experience. *Functional Neurology, 21*(4), 187-91.

Cashel, C. M. (1994). Group dynamics: Implications for successful expeditions. *Journal of Wilderness Medicine, 5*, 163-170.

Centers for Disease Control and Prevention. (2010). The association between school based physical activity, including physical education, and academic performance. Retrieved from https://www.cdc.gov/healthyyouth/health_and_academics/pdf/pa-pe_paper.pdf

Chasnoff, I. J. (2014). Sensory integration: Shaping perceptions of the world; A newly emerging therapy for alcohol- and drug-exposed children. Retrieved from https://www.psychologytoday.com/us/blog/aristotles-child/201405/sensory-integration-shaping-perceptions-the-world

Cherry, K. (2018). How psychologists define attention. Retrieved from https://www.verywellmind.com/what-is-attention-2795009

Chiriboga, C. A., Starr, D., Kuhn, L., & Wasserman, G. A. (2009). Prenatal cocaine exposure and prolonged focus attention. *Developmental Neuroscience, 31*(1-2), 149-158. doi:10.1159/000207502

Cleary, S. E. (2002). *Dance movement therapy and sensory integration: An integrated approach to working with children* (Doctoral dissertation). Retrieved from pdfs.semanticscholar.org

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Thousand Oaks: Sage.

De Vries, D., Beck, T., Stacey, B., Winslow, K., & Meines, K. (2015). Music as a therapeutic intervention with autism: A systematic review of literature. *Therapeutic Recreation Journal, 49*(3), 220-238.

Dorrat, L. (2016). Music, storytelling and dance in early childhood. *Educating Young Children: Learning and Teaching in the Early Childhood Years, 22*(1), 19-22.

Dunbar, S. B. (1999). A child's occupational performance: Considerations of sensory processing and family context. *American Journal of Occupational Therapy, 53*(2), 231-235.

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics, 5*(1), 1-4.

Freundlich, B. M., Pike, L. M., & Schwartz, V. (1989). Dance and music for children with autism. *Journal of Physical Education, Recreation & Dance, 60*(9), 50-53. doi:10.1080/07303084.1989.10609812

Grahn, J. A., & Brett, M. (2007). Rhythm and beat perception in motor areas of the brain. *Journal of Cognitive Neuroscience, 19*, 893–906. doi: 10.1162/jocn.2007.19.5.893

Grönlund, E., Renck, B., & Weibull, J. (2005). Dance/movement therapy as an alternative treatment for young boys diagnosed as ADHD: A pilot study. *American Journal of Dance Therapy, 27*(2), 63-85. doi:10.1007/s10465-005-9000-1

Guo, J. (2014). What happens when you take away disability benefits from kids and their parents. Retrieved from https://www.washingtonpost.com/news/storyline/wp/2014/12/16/kids-dont-earn-more-when-their-disability-checks-disappear-but-their-parents-o/?noredirect=on&utm_term=.642789e362ce

Hales, D., Peersman, G., Rugg, D., & Kiwango, E. (2010). An introduction to triangulation. Retrieved from http://www.unaids.org/sites/default/files/sub_landing/files/10_4-Intro-to-triangulation-MEF.pdf

Hassan, Z. A., Schattner, P., & Mazza, D. (2006). Doing a pilot study: Why is it essential? *Malaysia Family Physician*, *1*(2-3), 70–73.

Health Grove by Graphiq. (2017). *Food access statistics for Carter County, Tennessee*. Retrieved from http://food-access.healthgrove.com/l/7387/Carter-County-Tennessee#Health&s=14BGur

Hoskin, R. (2012). The dangers of self-report. Retrieved from http://www.sciencebrainwaves.com/the-dangers-of-self-report/

Hove, M. J., Gravel, N., Spencer, R. M. C., and Valera, E. M. (2017). Finger tapping and pre-attentive sensorimotor timing in adults with ADHD. *Experimental Brain Research, 235*, 3663–3672. doi: 10.1007/s00221-017-5089-y

Iversen, J., & Balasubramaniam, R. (2016). Synchronization and temporal processing. *Current Opinion in Behavioral Sciences, 8*, 175-180. doi:10.1016/j.cobeha.2016.02.027

Jaeger, D. A., Suchan, B., Schölmerich, A., Schneider, D. T., & Gawehn, N. (2015). Attention functioning in children with prenatal drug exposure. *Infant Mental Health Journal, 36*(5), 522-530. doi:10.1002/imhj.21530

Janata, P. & Grafton, S. T. (2003). Swinging in the brain: Shared neural substrates for behaviors related to sequencing and music. *Nature Neuroscience, 6*(7), 682-687.

Juntunen, M. (2016). The Dalcroze approach: Experiencing and knowing music through the embodied exploration. In C. R. Abril & B. Gault (Eds.) *Approaches to Teaching General Music: Methods, Issues, and Viewpoints* (pp. 141-167). Oxford: Oxford University Press.

Karpati, F. J., Giacosa, C., Foster, N. E. V., Penhune, V. B., & Hyde, K. L. (2015). Dance and the brain: A review. *Annals of The New York Academy of Sciences*, *1337*(1), 140-146. doi:10.1111/nyas.12632

Killen, M. & Tickner, N. (2013). Peer pressure starts in childhood, not with teens. Retrieved from https://umdrightnow.umd.edu/news/peer-pressure-starts-childhood-not-teens

Kim, C. Y., & Chung, H. S. (2015). The effects of sensory integration based therapeutic dance program on sensory processing function and concentration improvement of ADHD children. *International Sport Science Conference*, 252.

Kingsford-Smith, A. (2018). Disguised in dance: The secret history of capoeira. Retrieved from https://theculturetrip.com/south-america/brazil/articles/disguised-in-dance-the-secret-history-of-capoeira/

Kouijzer, M. E., de Moor, J. M., Gerrits, B. J., Congedo, M., & van Schie, H.T. (2009). Neurofeedback improves executive functioning in children with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *3*, 145-162.

Kovacs, F. (2009). Test of divided attention. *Manual,* Pyramid Productions.

Kovacs, F. (2018). *Attention test: A short introduction*. Retrieved from http://www.how-psychology-tests-brain-injury.com/attention-test.html

Kovacs, F. (2016). Test of sustained selective attention. *Manual,* Pyramid Productions. Retrieved from http://pyramidproductions.nl.server41.firstfind.nl/Bijlage/TOSSA_manual.pdf

Kulinna, P. H., Stylianou, M., Dyson, B., Banville, D., Dryden, C., & Colby, R. (2018). The effect of an authentic acute physical education session of dance on elementary students' selective attention. *Biomed Research International, 2/5/2018*, 1-8.

Lai, G., Pantazatos, S. P., Schneider, H., and Hirsch, J. (2012). Neural systems for speech and song in autism. *Brain, 135*(3), 961–975.

Law, M., Cooper, B., Strong, S., Stewart, D., Rigby, P., & Letts, L. (1996). The person-environment-occupation model: A transactive approach to occupational performance. *Canadian Journal of Occupational Therapy, 63*, 9-23.

Leigh, S. (2016). Brain's wiring connected to sensory processing disorder: UCSF study shows measurable neurological differences in affected children. Retrieved from https://www.ucsf.edu/news/2016/01/401461/brains-wiring-connected-sensory-processing-disorder

Leon, A. C., Davis, L. L., & Kraemer, H. C. (2010). The role and interpretation of pilot studies in clinical research. *Journal of Psychiatric Research, 45*(5), 626-629.

Levin, K. (2018). The dance of attention: Toward an aesthetic dimension of attention-deficit. *Integrative Psychological & Behavioral Science, 52*(1), 129-151. doi:10.1007/s12124-017-9413-7

Limb, C. J. (2006). Structural and functional neural correlates of music perception. *The Anatomical Record Part A: Discoveries in Molecular, Cellular, and Evolutionary Biology, 288A*(4), 435-446. doi: 10.1002/ar.a.20316

Linebaugh, M. (2019). Can your disability benefits be taken away? Retrieved from https://www.alllaw.com/articles/nolo/disability/can-benefits-be-taken-away.html

Liu, J. (2004). Childhood externalizing behavior: Theory and implications. *Journal of Child and Adolescent Psychiatric Nursing, 17*(3), 93-103.

Lobo, Y. B., & Winsler, A. (2006). The effects of a creative dance and movement program on the social competence of head start preschoolers. *Social Development, 15*(3), 501-519. doi:10.1111/j.1467-9507.2006.00353.x

Lockhart, A. E. (2017). The effect of rhythmic proprioceptive input on attention in children with autism spectrum disorder (ASD): An exploratory study. *Open Access Thesis,* 661.

Retrieved from https://scholarlyrepository.miami.edu/cgi/viewcontent.cgi?article=1680&context=oa_theses

Luborsky, B. (2017). Helping children with attentional challenges in a Montessori classroom: The role of the occupational therapist. *NAMTA Journal*, *42*(2), 287–352. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=eric&AN=EJ1144540&site=eds-live&scope=site

Luiz, R. & Jorgensen, C. (2015). Music and sound elements in time estimation and production of children with attention deficit/hyperactivity disorder (ADHD). *Frontiers in Psychiatry, 6*, 127. Retrieved from https://doi.org/10.3389/fpsyt.2015.00127/full

Madison, G., Gouyon, F., Ullen, F., & Hornstrom, K. (2011). Modeling the tendency for music to induce movement in humans: First correlations with low level audio descriptors across music genres. *Journal of Experimental Psychology: Human Perception and Performance*, 37(5), 1578-1594. doi:10.1037/a0024323

Manning, F. & Schutz, M. (2013). "Moving to the beat" improves timing perception. *Psychonomic Bulletin and Review*, *20*(6), 1133-1139. doi:10.3758/s13423-013-0439-7

Mathias, R. (1998). Prenatal exposure to drugs of abuse may affect later behavior and learning. Retrieved from https://archives.drugabuse.gov/news-events/nida-notes/1998/11/prenatal-exposure-to-drugs-abuse-may-affect-later-behavior-learning

Microsoft Corporation. (2016). Software download. Retrieved from https://office.microsoft.com/excel/

Mullinix ,H. (2013). Drug-dependent babies face many challenges after birth. Retrieved from https://www.crossville-chronicle.com/news/local_news/drug-dependent-babies-face-many-challenges-after-birth/article_ed0af76e-4831-575c-9b2e-1a43e316ff40.html

My Byline Media. (2019). Readability formulas. Retrieved from

http://www.readabilityformulas.com/free-readability-formula-tests.php

Nelson, D. L., Kielhofner, G., & Taylor, R.R. (2017). Quantitative research designs: Defining variables and their relationships with one another. In R.R. Taylor (Ed.), *Research in occupational therapy: Methods of inquiry for enhancing practice* (pp. 244-259). Philadelphia: F. A. Davis.

Nelson, K. L. (2018). Is it flu? And when do you need to go to the ER? Public health expert offers guidelines. Retrieved from https://www.knoxnews.com/story/news/health/2018/12/19/flu-public-health-experts-guidelines-hospital-visit/2365432002/

Onderwater, A. (2004). Validating a new attention test: The TOSSA; a pilot study. MA Thesis University of Leiden.

Ono, Y., Nomoto, Y., Tanaka, S., Sato, K., Shimada, S., Tachibana, A., Bronner, S., & Noah, J. A. (2014). Frontotemporal oxyhemoglobin dynamics predict performance accuracy of dance simulation gameplay: Temporal characteristics of top-down and bottom-up cortical activities. *NeuroImage, 85*(1), 461-470. doi: 10.1016/j.neuroimage.2013.05.071

Ortlipp, M. (2008). Keeping and using reflective journals in the qualitative research process. Retrieved from https://pdfs.semanticscholar.org/3480/1cce078f2ec249113750fb9fcb6cb79fd874.pdf?_ga=2.116027714.575930194.1553360664-247643018.1553360664

Pappas, S. (2011). As schools cut recess, kids' learning will suffer, experts say. Retrieved from https://www.livescience.com/15555-schools-cut-recess-learning-suffers.html

Patrick, S. W., Davis, M. M., Lehmann, C. U., & Cooper, W. O. (2015). Increasing incidence and geographic distribution of neonatal abstinence syndrome: United States 2009 to 2012. *Journal of Perinatology, 35*(8), 650-655.

Piller, A. (2019). Piller child development: Vestibular input. Retrieved from

https://www.pillerchilddevelopment.com/vestibularInput.php

Puyjarinet, F., Begel, V., Lopez, R., Dellacherie, D., & Dalla Bella, S. (2017). Children and adults with attention-deficit/hyperactivity disorder cannot move to the beat. *Journal of Scientific Reports, 7*, 11550. doi: 10.1038/s41598-017-11295-w

Ranger, L. (2018). Prenatal exposure to opiates, illicit substances associated with ADHD, autism in offspring. Retrieved from https://www.psychiatryadvisor.com/childadolescent-psychiatry/prenatal-opiate-exposure-predicted-adhd-autism-in-offspring/article/760318/

Richter, J., & Ostovar, R. (2016). "It don't mean a thing if it ain't got that swing:" An alternative concept for understanding the evolution of dance and music in human beings. *Frontiers in Human Neuroscience, 10,* 485. doi: 10.3389/fnhum.2016.00485

Rickson, D. J. (2006). Instructional and improvisational models of music therapy with adolescents who have Attention Deficit Hyperactivity Disorder (ADHD): A comparison of the effects on motor impulsivity. *Journal of Music Therapy, 43*(1):39-62.

Roden, I., Konen, T., Bongard, S., Frankenberg, E., Friedrich, E. K., & Kreutz, G. (2014). Effects of music training on attention, processing speed and cognitive music abilities: Findings from a longitudinal study. *Applied Cognitive Psychology, 28*(4), 545-557.

Saarman, E. (2006). Feeling the beat: Symposium explores the therapeutic effects of rhythmic music. Retrieved from https://news.stanford.edu/news/2006/may31/brainwave-053106.html

Scalzo, F., O'Connor, D. A., Orr, C., Murphy, K., & Hester, R. (2016). Attention diversion improves response inhibition of immediate reward, but only when it is beneficial: An fMRI study. *Frontiers in Human Neuroscience, 10,* 429. doi: 10.3389/fnhum.2016.00429

Schoen, S. A., Miller, L. J., Brett-Green, B. A., & Nielsen, D. M. (2009). Physiological and behavioral differences in sensory processing: A comparison of children with autism spectrum disorder and sensory modulation disorder. *Frontiers in Integrative*

Neuroscience, *3*, 29. doi:10.3389/neuro.07.029.2009

Schroeder, C. E., Wilson, D. A., Radman, T., Scharfman, H., & Lakatos, P. (2010). Dynamics of active sensing and perceptual selection. *Current Opinion in Neurobiology, 20*, 172–176.

Singer, E. (2007). A neurological basis for ADHD. Retrieved from https://www.technologyreview.com/s/408381/a-neurological-basis-for-adhd/

Slater, J. L., & Tate, M. C. (2018). Timing deficits in ADHD: Insights from the neuroscience of musical rhythm. *Frontiers in Computational Neuroscience, 12* (51), 1-8. Retrieved from https://doi.org/10.3389/fncom.2018.00051/full

Stutterheim, E. (2006). Attention testing to the bottom: Cross-validation of various attention tests in a population of chronic NAH patients with severe multiple limitations (doctoral thesis). University of Leiden, Leiden, Netherlands.

Taylor, R. R. (2017). Securing samples and performance sites. In R.R. Taylor (Ed.), *Research in occupational therapy: Methods of inquiry for enhancing practice* (pp. 163-179). Philadelphia: F. A. Davis.

Tennessee Department of Education. (2017). *Tennessee early intervention system*. Retrieved from http://tn.gov/education/topic/tennessee-early-intervention-system-teis

Tennessee Department of Health. (2015). *Drug-dependent newborns (neonatal abstinence syndrome).* Retrieved from https://tn.gov/assets/entities/health/attachments/Oct_2015_NAS_Monthly_Report.pdf

United States Department of Education. (2017). *Programs: National blue ribbon schools program*. Retrieved from https://www2.ed.gov/programs/nclbbrs/index.html

United States Department of Health and Human Services. (2003). *Summary of the HIPAA privacy rule.* Retrieved from https://www.hhs.gov/sites/default/files/privacysummary.pdf

United States Department of Justice. (2018). *Information and technical assistance on the*

Americans with disabilities act. Retrieved from https://www.ada.gov/

United States National Library of Medicine. (2017). *Neonatal abstinence syndrome.* Retrieved September 20, 2017, from https://www.ncbi.nlm.nih.gov/pubmedhealth/PMHT0024264/

Wass, T. S., Simmons, R. W., Thomas, J. D., & Riley, E. P. (2002). Timing accuracy and variability in children with prenatal exposure to alcohol. *Alcoholism: Clinical and Experimental Research, 26*(1), 1887-1896.

Weinbach, N., Kalanthroff, E., Avnit, A., & Henik, A. (2015). Can arousal modulate response inhibition? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 41*(6), 1873–1877. http://dx.doi.org/10.1037/xlm0000118

Welch, A. (2018). Kids start caring about their reputations as early as kindergarten. Retrieved from https://www.cbsnews.com/news/kids-care-about-their-reputations-as-early-as-kindergarten/

Appendix A. IRB Approval

IRB Approval Notification: Protocol #2117

Hello Lindsay Williams,

Congratulations! The Institutional Review Board at Eastern Kentucky University has approved your application for the study entitled, **"Movement Opportunities through Vestibular Engagement to Rhythm (MOVER): A Therapeutic Movement-to-Music Program for Children with Attention Deficits."** Your approval is effective immediately and will expire on December 7, 2019.

Principal Investigator Responsibilities: It is the responsibility of the principal investigator to ensure that all investigators and staff associated with this study meet the training requirements for conducting research involving human subjects, follow the approved protocol, use only the approved forms, keep appropriate research records, and comply with applicable University policies and state and federal regulations.

Consent Forms: All subjects must receive a copy of the attached consent form as approved with the EKU IRB approval stamp. Copies of the signed consent forms must be kept on file unless a waiver has been granted by the IRB.

Adverse Events: Any adverse or unexpected events that occur in conjunction with this study must be reported to the IRB within ten calendar days of the occurrence.

Research Records: Accurate and detailed research records must be maintained for a minimum of three years following the completion of the research and are subject to audit.

Changes to Approved Research Protocol: If changes to the approved research protocol become necessary, a Protocol Revision Request must be submitted for IRB review, and approval must be granted prior to the implementation of changes. Some changes may be approved by expedited review while others may require full IRB review. Changes include, but are not limited to, those involving the study's completion date, personnel, consent forms, subjects, data collection instruments, and procedures.

Annual IRB Continuing Review: This approval is valid through the expiration date noted above and is subject to continuing IRB review on an annual basis for as long as the study is active. It is the responsibility of the principal investigator to submit the annual continuing review request and receive approval prior to the anniversary date of the approval. Continuing reviews may be used to continue a project for up to three years from the original approval date, after which time a new application must be filed for IRB review and approval.

Final Report: Within 30 days from the expiration of the study's approval, a final report must be filed with the IRB. A copy of the research results or an abstract from a resulting publication or presentation must be attached. If significant new findings are provided to the research

subjects, a copy must be also be provided to the IRB with the final report. To submit your final report, please follow the steps below:

1. Log in to your InfoReady Review account using your EKU credentials (user name and password, not email address).
2. Click the Applications link from the top menu bar.
3. Select the project title for your study.
4. Click the Progress Report button from the right sidebar menu.
5. Complete the information fields and attach copies of any required documents.
6. Click the Finalize button to submit your report. This button is located just above the attachment fields.

If you have questions about this approval or reporting requirements, contact the IRB administrator at lisa.royalty@eku.edu or 859-622-3636.

For your reference, comments that were submitted during the review process are included below. Any comments that do not accompany an "I approve" response have been provided to you previously and were addressed prior to the review process being completed.

Appendix B. Example TOSSA

Test of Sustained Selective Attention for Windows Version 4.0

Surname Research Assistant 3
Date of Birth 5/30/1997
Age 21
Date of Test 10/31/2018 3:02:40 PM
Education 7
Sex Male
Diagnosis Intern
Remarks

Practice:
stim 23332423444344242323
1 hhh ffh h
2

Longest isi: 1640 ms Shortest isi: 440 ms

123456789012345678901234567890123456789012345678901234567890 stim
242343443432242342323223342342342234234233324234443442423234 1 ffhfh h h hhf
h h h h hhh h h h h h h h h h h h hh h h h h hhh h h f ofo 2 h h h h h h
h hh h h h h hhh h ffof o of h h h h h h h hh h h h h fohh h voff f o v
block h o f v t 1 38 2 6 0
0
2 33 6 8 2 0
Tot: 71 8 14 2 0

Total number of errors on 2: 4
Total number of errors on 4: 10
Total number of premature errors on 4: 1

Total stimuli administered: 240 Total time test: 494.5 sec.

Compared to the Healthy group N=224:
Concentration strength (CS): 82.8 quite obvious concentration problem: d2
Detection Strength (DS): 88.8 considerable loss of focus, no deficit: d2
ResponsInhibStrength (RIS): 93.3 slight impulse control deficit: d1
Compared to Right Stroke patients N=297: decile 8
Compared to Left Stroke patients N=284: decile 8
Compared to severe Traumatic Brain Injury patients N=145: decile 8
Compared to Other neurological patients N=293: decile 7
Compared to WAD type II patients N=82: decile 5

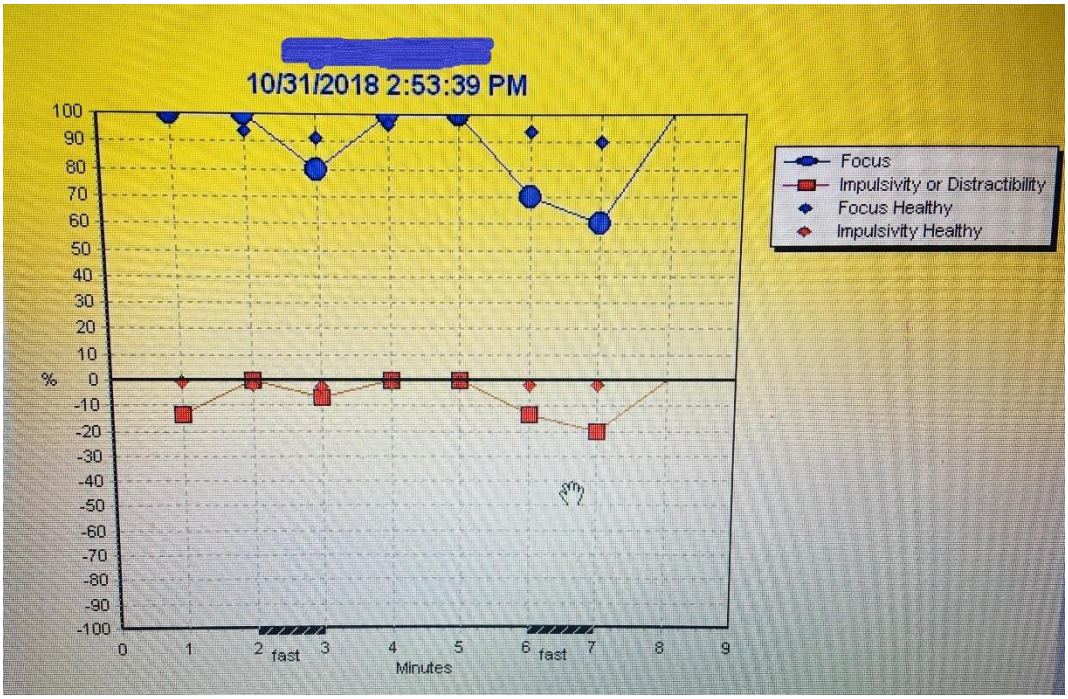
Profile suggests Conditional Impulsivity

Profile suggests Mental Slowness
Profile suggests Enhanced Fatigability

SADS (influence Speed on DS): -22.5
slight influence of speed on focus: d2 LADS (Influence Length of test on DS): -13.2 obvious influence of length on focus: d1 SARIS (Influence Increased Speed on RIS): -6.9
moderate influence of speed on impulse control: <d1, <1p LARIS (Influence Length of Test on RIS): -3.5 obvious influence of length on impulse control: d1

DST (DS in slowest half: 100.0
DSS (DS in fastest half: 77.5
DSblock1 (DS in 1st half: 95.0
DSblock2 (DS in 2nd half: 82.5

RIST (RIS in slowest half): 96.7
RISS (RIS in fastest half): 90.0
RISblock1 (RIS in 1st half): 95.0
RISblock2 (RIS in 2nd half): 91.7
CST (CS in slowest half): 96.7
CSS (CS in fastest half): 69.8
CSblock1 (CS in 1e blok): 90.3
CSblock2 (CS in 2e blok): 75.6
SACS (influence of speed on CS): -27.8
LACS (influence of length on CS): -16.2



Appendix C. MOVER Caregiver Survey

M.O.V.E.R Program Survey

This survey is being conducted by Lindsay B. Williams, Occupational Therapy Doctoral student at Eastern Kentucky University. The results of this survey will be used to gather information regarding behaviors that your child demonstrates within the school, home, and community environments. The second section will be utilized to collect demographic information.

If you choose to participate, none of your personal statements will be published by the researcher. Instead, all information will be grouped, and no individual responses will be identified. Please be aware that even if you agree to participate, you are free to withdraw at any time without penalty. Completion of the survey indicates your willingness to participate in this project and that you are at least eighteen years old.

If you have any questions regarding this survey or its intended use, please contact Lindsay Williams at 423-342-7889.

Part 1: BEHAVIORAL CONCERNS

In this survey, we would like to ask you about your child's daily experiences as well as about behaviors that they demonstrate.

Instructions: In the first column, circle the number that explains how often your child participates in the listed behaviors with the following rating scale:

1=Never
2=Rarely (e.g. a few times a year)
3=Occasionally (e.g. at least once monthly)
4=Frequently (e.g. weekly)
5=Always (daily)

In the second column, circle the number that best explains your level of concern regarding your child's participation in the listed behavior area using the following rating scale:

1= Low Concern (I am not worried about this behavior at all.)
2= Minor Problem (This behavior is not my main concern right now.)
3= Moderate Issue (My child needs extra help because of this.)
4= Major Problem (My child does this, and it is a problem.)
2= High Concern (I am extremely worried about this behavior.)

	Frequency of participation in the listed activities						Level of concern that you have regarding this area at this time				
	Never			Always			Low			High	
1. Is in constant motion (spinning, pacing, rocking, etc.)	1	2	3	4	5		1	2	3	4	5
2. Is unable to sit or stay seated	1	2	3	4	5		1	2	3	4	5
3. Has difficulty maintaining attention on adult-directed activities	1	2	3	4	5		1	2	3	4	5
4. Seems uninterested in academic material	1	2	3	4	5		1	2	3	4	5
5. Engages in socialization with peers that is not age-appropriate	1	2	3	4	5		1	2	3	4	5
6. Has difficulty following directions	1	2	3	4	5		1	2	3	4	5
7. Needs several verbal cues to return to tasks to complete them	1	2	3	4	5		1	2	3	4	5
8. Plays briefly with a toy before wanting another	1	2	3	4	5		1	2	3	4	5
9. Has difficulty with transitions	1	2	3	4	5		1	2	3	4	5
10. Lacks safety awareness	1	2	3	4	5		1	2	3	4	5
11. Is impulsive and lacks self-control	1	2	3	4	5		1	2	3	4	5
12. Does not interact appropriately with adults	1	2	3	4	5		1	2	3	4	5
13. Has difficulty waiting (e.g. in line, for his/her turn, in a waiting area, etc.)	1	2	3	4	5		1	2	3	4	5
14. Has tantrums or behavior issues at school	1	2	3	4	5		1	2	3	4	5
15. Is easily distracted by auditory and/or visual stimuli	1	2	3	4	5		1	2	3	4	5

Part 2: DEMOGRAPHIC INFORMATION

Please tell us a little information about yourself. This information is anonymous and does not require any identifying information. You may choose to skip any of these optional survey components.

1. **What is your relationship to the child who is participating (please circle one)?**

(A) Parent (B) Foster Parent/Adopted Parent (C) Grandparent (D) Caregiver (e.g. Nanny/Babysitter)
(B) (E) Other _____

2. **What grade is your child in currently?**

(A) Kindergarten (B) First Grade (C) Second Grade (D) Third Grade (E) Fourth Grade

(F) Fifth Grade

3. What type of drugs was your child exposed to prenatally (circle all that apply)?

(A) Over-the-counter medications (B) Caffeine (C) Nicotine (D) Prescription medications (E) Narcotics

(F) Illicit Substances (G) Alcohol (H) Other_____

☐ Check this box if your child was not exposed to any drugs or medications before birth

4. Which geographical area best describes where your child resides?

(A) Carter County, TN (B) City of Elizabethton, TN (C) Washington County, TN (D) Johnson City, TN (E) Other

Please use this space to tell us about any unaddressed attention and/or behavioral problems your child demonstrates.

Please return this survey to the person who gave it to you or to one of the research assistants who are wearing MOVER identification badges.

Thank you for your feedback!

Appendix D. MOVER Program Plan Example

MOVER Session 2

Staff Needed: 4 Research Assistants for Safety/Behavior Regulation within the session
Materials Needed: Downloaded recorded music, carpet squares (enough for pre-registered number of children and a few extra for more children), rhythm stix, djembe drum, boomwhackers, snack (based on allergy information provided by parents via pre-registration), variety of obstacle course items (e.g. tunnel, trampoline, balance discs, Airex platforms, balance beam, crash pad, spiky mats, stepovers, etc.), quiet space for children who need a rest or area for calming
Target Timeframe: 1 hour

Check-in (4:45-5:00)	• Children sign in at front desk. • Snack is provided in office space with calming music (same as in week 1). • Children are taken by research assistant to dance space when it is time to begin.
Introduction (5:00-5:15)	• Children are in a circle on carpet squares (physical boundaries). Children re-introduce themselves and remind peers of their "sign" for their name which is a movement created in the first session. (Verbal and/or visual cues may need to be provided by therapist or staff member). • Each child imitates other children's movement sign. • To Sandstorm (3:52), therapist guides children in all signs in order around the circle with therapist's sign being the last movement.
Activity #1 (5:15-5:20)	• Children participate in guided movement-to-music utilizing rhythm stix and/or boomwhackers to Cotton Eyed Joe--Amadeus instrumental version (3:48) including: hitting together, tapping a peer's stix, hitting the floor/wall, high versus low, and left versus right, start and stop.
Activity #2 (5:20-5:25)	• Children participate in dancing activity surrounding African djembe

	drum with drumming/vibration component to Digeridoo music (turn off after first song at 3:00).
Activity #3 (5:25-5:30)	• Children participate in animal yoga movements to Nobody Gonna Break My Stride (3:05) with visual examples of each movement provided by therapist and research assistants. • Poses will be taught prior to the rhythmic music's introduction.
Activity #4 (5:30-5:40)	• Children participate in building obstacle course from the variety of objects available. • Children are encouraged to work together, and staff may assist as needed for safety, behavior, and needed physical/cognitive assistance. • Children then participate in obstacle course 3x each (individually) to Happy (4:01). • Children clean up materials after completion.
Activity #5 (5:40-5:50)	• After teaching the dance moves (belt-buckle shine, whirly bird, and statue), children participate in guided dance to "Say the Dance, Do the Dance" (1:58)
Conclusion (5:50-6:00)	• Children return to circle of carpet squares and are prompted to tell which activity was their favorite today, and suggestions are taken for props, music, and/or movements to incorporate into next session. • Research assistants take notes on these suggestions to modify next session. • Children are then dismissed to caregivers.