THE IMPACT OF PHYSICAL ACTIVITY ON COGNITIVE FUNCTION IN YOUTH WITH DISABILITIES

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THE IMPACT OF PHYSICAL ACTIVITY ON COGNITIVE FUNCTION IN YOUTH WITH DISABILITIES

A Thesis Presented for the Master of Science Degree
The University of Tennessee, Knoxville

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The purpose of this study is to determine the impact of physical activity on cognition in youth with disabilities. This study is in collaboration with the TRiPS (Therapeutic Recreation in Public Schools) program at the University of Tennessee. Project TRiPS is a service-learning course where, paired with in-class instruction, students implement therapeutic recreation services in special education classrooms with the intention of deriving specific outcomes. More specifically, 30-minute physical activity interventions were implemented during each TRiPS session using an intervention protocol called FunDoRoo. A pretest posttest quasi-experimental design was used to explore the impact of the physical activity on students’ cognition. Data related to the impact of acute and chronic physical activity on cognitive functioning in youth with disabilities was collected via the modified Corsi Block Test (PathSpan).
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CHAPTER ONE

INTRODUCTION

Therapeutic Recreation is a health care profession that focuses on the use of recreation and leisure to enhance the quality of life among individuals with deficits of any kind (Green et al., 2018). According to the American Recreation Therapy Association (2019), individuals served by Therapeutic Recreation Specialists may have intellectual disabilities, physical disabilities, mental health needs, rehabilitations needs, or age-based needs. Services provided by therapeutic recreation specialists include goal-oriented activities that focus on increasing at least one of the following areas: cognitive functioning, physical activity, spirituality, emotional wellbeing, and social interaction (American Therapeutic Recreation Association [ATRA], n.d.). Therapeutic Recreation services are provided by Certified Therapeutic Recreation Specialists (CTRS). A CTRS evaluates an individual’s functional levels through various assessments to create treatment plans that increase functioning one or more of the following areas of cognition, physical ability, social development and emotional wellbeing. Assessments are utilized to set goals and plan intervention strategies for clients. Therapeutic Recreation specialists also provide leisure education to help their clients gain recreation-related skills as well as opportunities within the community (Northeast Passage, n.d.).

Therapeutic recreation services are offered in a variety of settings that include, but are not limited to the following: school systems, hospitals, mental health facilities, skilled nursing facilities, and community programs (Bureau of Labor Statistics, n.d.).
Therapeutic recreation services within school systems are designed to provide opportunities that can enhance various skillsets across multiple domains for individuals with disabilities. Specifically, a CTRS can play a crucial role in increasing skills required for physical activities. Recent research implies that children with disabilities becoming more physically inactive, and suggests the amount of physical activity within a school day should be increased (Rimmer & Rowland, 2008). Therapeutic Recreation services can play an integral role in enhancing various skills needed for physical activity as well as resource identification. A CTRS in a school also focuses on enhancing the quality of physical activity that students with disabilities are receiving by training educators, recreational personnel and even family members (Etzel-Wise & Mears, 2004). Many Therapeutic Recreation specialists have recently stressed the importance of incorporating physical activity and exercise into practice (Kasser & Lytle, 2015).

Physical activity and exercise is extremely beneficial for overall health. Several studies on physical activity have examined beneficial outcomes, such as improvement in cognitive function. More specifically, the relationship between physical activity and cognition has been further explored in individuals with disabilities and suggest a positive relationship (Alesi et al. 2014). Additionally, a recent systematic review examined the effect of physical activity on cognitive performance in youth with Down syndrome. This examined the effects of acute and chronic physical activity and suggested positive outcomes from both. Acute bouts of physical activity were described as physiological changes that occurred after a single session of physical activity and chronic was defined as changes after repeated sessions of physical activity (Nocera, Wozencroft, & Coe,
Furthermore, this review suggested that Therapeutic Recreation specialists utilize physical activity to enhance outcomes of their programs.

Although research on physical activity and cognition is limited in youth with disabilities, some studies have shown physical activity to have a positive influence on cognitive function. A recent, related study focused on primary grade students and intermediate elementary grade students with intellectual disabilities engaging in daily physical activity protocols prior to engaging in academic work. Improvement in academic work was shown in both language arts and mathematics for the intermediate elementary grade students, but the results of the primary grade students were inconsistent (Brett et al., 2012). While preliminary work has been done in this area, it only begins to address the relationship between physical activity and cognition. Additional research is needed to further examine the impact of physical activity on cognition and academic performance.

**Purpose**

The purpose of this research is to determine if cognitive functioning is impacted by physical activity in youth with disabilities. Two specific aims of this study include: 1) examining the impact of an acute bout of physical activity on cognitive function in youth with disabilities and 2) examine the impact of chronic physical activity on cognitive function in youth with disabilities.

**Problem Statement**

Physical inactivity in children is a predominate concern due to obesity rates in the United States (Ogden, Carroll, Kit, & Flegal, 2014). Individuals with disabilities have
even higher rates of obesity, lower levels of physical activity, and hold a higher risk for secondary health conditions (Rimmer & Rowland, 2008). According to Centers for Disease Control and Prevention (2010), obesity rates for children with disabilities are 38% higher than children without disabilities. Additionally, 20% of youth with disabilities ages 10-17 are obese (Centers for Disease Control and Prevention, 2010). Additionally, there are limited leisure and athletic programs available for youth with disabilities compared to their typically developing peers, which results in even higher risks for health-related problems for this population (Green et al., 2018). Engaging in at least 60 minutes of physical activity per day has been found to increase health in several areas. Most youth spend approximately eight hours a day at school, but are not engaging in more than 30 minutes of physical activity (Centers for Disease Control and Prevention, 2010). According to the Centers for Disease Control and Prevention (2010), students who engage in at least an hour of moderate to vigorous physical activity regularly have higher levels of fitness, lower body fat, and stronger bones and muscles. It is also suggested that physical activity has brain health benefits, including academic performance, memory, and reduced symptoms of depression.

According to the National Council for Therapeutic Recreation Certification, there are less than 2% of Therapeutic Recreation Specialists working in the education environment. This shows the under-representation and need for TR services within the school system. Therapeutic Recreation programs have potential to expand by gaining support by the public school system, increasing awareness and knowledge of
therapeutic recreation as a related service, and forming relationships with the Individualized Education Planning (IEP) team.

**Significance of Study**

This study is significant due to the lack of physical activity opportunities for youth with disabilities. It is also significant due to the lack of engagement in physical activity when opportunities are available. This is due to lack of information available for how to modify and adapt activities for individuals with disabilities. Studies have shown many beneficial outcomes from engaging in physical activity for individuals with and without disabilities. One major outcome that studies have focused on is the positive relationship between physical activity and cognitive functioning (Tan, Pooley, & Speelman, 2016). This study utilizes and examines the outcomes of the FunDoRoo program, a new physical activity curriculum that was designed for youth with and without disabilities. Physical activity outcomes have been examined in many other populations, but there has been limited research on physical activity and youth with disabilities. For this study, the physical activity intervention outlined in the FunDoRoo program was implemented in the Project Therapeutic Recreation in Public Schools (TRiPS) program at the University of Tennessee. Through this study, the goals of the TRiPS program have been expanded to increase physical activity within Comprehensive Development Classrooms.
Limitations

Due to circumstances out of the researchers control, there were certain limitations that occurred during this study. Limitations of this study include the following:

1. Due to absences of the students with disabilities and school closings, the number of FunDoRoo protocols that students engaged in varied by student.

2. Since this was the initial implementation of the FunDoRoo program in TRiPS, the college students implementing the protocols were challenged with modifying the activities to meet the abilities of the students with varying levels of disabilities.

3. Although every effort was made to obtain consent from all students involved in the TRiPS program, there were very a small number of consent forms that were signed and returned back to the researcher. This resulted in the study having a small sample size and the inability to include and analyze all data routinely collected on the students with disabilities.
Delimitations

There are certain factors within the study that establish parameters. Delimitations of this study include the following:

1. As a result of the TRiPS program eligibility criteria, the population of the study focused on individuals 7-21 in Comprehensive Development Classrooms within Knox County.

2. Due to the time constraints of each Comprehensive Development Classroom session, some of the FunDoRoo protocols were condensed from their original timeframe indicated.

3. Due to the number of weeks in the TRiPS program, data was collected over a period of eight-weeks.
Definitions

**Acute**: Health effects or responses of physical activity that refer to those positive health-related changes that occur in the hours after a session of physical activity (Tipton, 2001).

**Chronic**: Effects associated with physical activity that occur over time due to changes in the structure or function of various systems, independent of acute effects (Tipton, 2001).


**FunDoRoo**: A mobile application that contains physical activity curriculum for youth with disabilities.

**PathSpan**: A fully configurable, iPad version of a popular visual-spatial memory test—the Corsi Block-Tapping Test. A PathSpan session for a participant displays trials in which a sequence of lighted buttons is displayed for the participant to ‘play back’ by touching the buttons in the same order (Hume, 2014).

**Project TRiPS**: A program within the Therapeutic Recreation department at the University of Tennessee where undergraduate and graduate students conduct therapeutic recreation programs in Comprehensive Development Classrooms once a week for approximately ten weeks.

**Protocol**: A predetermined FunDoRoo lesson plan that is conducted across all schools within the TRiPS program for the first 30 minutes of the one hour TRiPS session each week.
CHAPTER TWO

LITERATURE REVIEW

History of Therapeutic Recreation in Public Schools

Therapeutic recreation is a product of the settlement house movement in the 1800’s and was originally referred to as wholesome recreation. The first documented services included play areas for children and other recreational opportunities for adults established to ease the transition for individuals immigrating into American cities during the Industrial Revolution (Carter, Van Andel & Robb, 2003). Services later began to focus specifically on providing services to individuals with special needs. Therapeutic recreation services were first provided in schools for children with developmental disabilities in the 1900’s (Carter, Van Andel & Robb, 2003). It was not until 1967 that the bureau of education for the handicapped established physical education and recreation for children with disabilities. This became the largest federal program for training, research and special projects. Then, in 1975 the Education of All Handicapped Children Act was established. This required free and appropriate education for all handicapped children. Physical education was then listed as a direct service and recreation as a related service (Austin & Crawford, 2001). Amendments were made to the Education for Handicapped Children Act in 1983, 1986, and again in 1990. These amendments recognized the need of recreational therapy for infants and toddlers as early as possible and expanded funding this this area. In 1990, the Education for Handicapped Children Act was renamed as the Individuals with Disabilities Education Act (IDEA). During this time, Therapeutic Recreation Specialist’s worked with local advocacy groups such as
the Association for Retarded Citizens to market Therapeutic Recreation in select school systems (Austin & Crawford, 2001). In 1995, The University of North Carolina at Chapel Hill supported professionals to incorporate Therapeutic Recreation as a related service through academic preparation and training (Center for Recreation and Disability Studies, 1992). In 1997, amendments were made to the IDEA that mandated transition planning to start at 14 years of age to 16. Changes also included the Individualized Education Plan (IEP) now had to include extracurricular activities, such as recreation, to meet IEP goals. Most importantly, the amendments made to the IDEA in 1977 included that a Certified Therapeutic Recreation Specialist (CTRS) is no longer identified as the qualified person to provide recreation services and the definition of recreation became less detailed. In 2004, the IDEA was reauthorized to include Therapeutic Recreation as a related service. Also, as of 2004, the IDEA aligns with the No Child Left Behind Act. It now sets higher expectations for students with disabilities, expects the use of evidence-based practice, and increases emphasis on preventing learning and behavioral problems (Center for Recreation and Disability Studies, 1992).

**Project Therapeutic Recreation in Public Schools**

The Therapeutic Recreation concentration at the University of Tennessee prepares students for future careers in this field through experiential learning opportunities. Therapeutic Recreation in Public Schools, also known as Project TRiPS, is one unique aspect of the Therapeutic Recreation curriculum at the University of Tennessee. Through this program, undergraduate and graduate students from the University of Tennessee are assigned to two of the nine Comprehensive Development
Classrooms within Knox and Sevier County that has agreed to partner with the University of Tennessee. Upon the first visitation of the TRiPS program, college students are paired 1:1 or 1:2 with students with disabilities. The teachers of the Comprehensive Development Classroom provide the college students with the goals and objectives from the Individualized Education Plan (IEP) of each student with a disability. Through observation and documentation, the college students are able to evaluate any progress made on the goal(s) they were working on during the TRiPS sessions. (Shultz, Wozencroft, Cihack, 2015). According to Waller and Wozencroft (2010) Project TRiPS enhances various necessary skills among students with disabilities through recreational activities.

Additionally, through Project TRiPS, college students have the opportunity to implement one hour of therapeutic recreation activities each session. This program is designed to teach college students the role of a practicing Certified Therapeutic Recreation Specialist and gain knowledge of and experience with assessment tools, developing lesson plans, facilitating therapeutic activities and the documentation process.

**Benefits of Therapeutic Recreation in Public Schools**

Therapeutic Recreation specialists assess their clients in all areas to plan interventions and create treatment plans. In schools, a CTRS creates interventions based on findings in the assessment process as well as goals and objectives listed on the IEP. Students can benefit from school-based recreational therapy services in the following areas: increased self-esteem and confidence, increased knowledge of leisure
and leisure resources, increased functional abilities, enhanced social skills, enhanced emotional stability, improvement in academic work (Etzel-Wise & Mears, 2004). Within the school setting, a CTRS works collaboratively with classroom teachers, adapted physical education teachers, occupational therapists, physical therapists and speech and language pathologists. A recreation therapist plays a significant role with the school, community, and family (Etzel-Wise & Mears, 2004; Bambara, Browder & Koger, 2006; Browder & Cooper, 2001; Kleinert, Miracle & Sheppard-Jones, 2007; Rynders & Schlein, 1993; Waller & Wozencroft, 2010).

A recent study shows significant increase in social interaction behaviors of youth with disabilities through therapeutic recreation interventions in schools. Specifically, in the following three areas: motor-gestural positive behavior, vocal-gestural positive behavior and response to the environment (Shultz, Wozencroft, & Cihak, 2017). In regard to motor gestural positive, this means that there was an increase in movements that caused a student with a disability’s head, arms or feet to come into direct contact with the body of someone else in the class or involved waving or extending arms directly toward another person. This could have also involved the increase of placing hands on the materials of an activity being implemented. In regard to vocal-gestural positive, this means that there was an increase in all vocalizations as well as non-verbal responses emitted toward any staff member in the classroom. In regard to response to the environment, this means that there was an increase in behaviors made by students with disabilities that followed in close contiguity (3 seconds or less) to the response of another person within the classroom and shows direct relationship to a previous
response. This could also mean an increase in participation in an interaction focusing on some type of activity with another person in the classroom (Shafer et al., 1984).

There are many beneficial outcomes of therapeutic recreation in schools including the enhancement of social, recreational, and behavioral skills (Waller & Wozencroft, 2010). Engagement in recreation activities is also beneficial to many health factors in youth with disabilities. It is crucial for recreation therapists’ to enhance recreation and leisure opportunities for students with disabilities due to the lack of available opportunities. Youth with disabilities are more likely to develop more health problems and have a greater risk of obesity because of the limited opportunities to participate in recreation and leisure (Green et al., 2017). Research has shown that regular activity may overall improve physical fitness in youth and adolescents with disabilities (e.g. Murphy & Carborne, 2008).

**Benefits of Physical Activity in Schools**

There are numerous benefits of physical education and physical activity participation for school-age children. In general, physical activity benefits for children include improvement in strength and endurance, building healthy bones and muscles, controlling weight and normalizing blood pressure and cholesterol (Green et al., 2018). Studies focused on physical education claim that benefits include enhanced development of mind and body, self-confidence, social and cognitive development, and academic achievement (Bailey, 2006).

For many children, school systems are the main source of physical activity opportunities. It is extremely important for children to develop basic movement skills
through physical activity participation to set a foundation for the continuation and progression of physical activity. Studies have shown that children that do not acquire an adequate base of movement skills are more likely to be excluded from participation in organized sports and play experiences (Bailey, 2006).

Physical activity within a school setting is typically broken down into four different categories: physical education, recess, classroom based, and extracurricular. Recent studies have found positive associations between physical activity and academic performance in each of these categories. Physical education and classroom based physical activity have been found to have positive associations with cognitive skills and academic achievement. Recess and extracurricular activities have been shown to also have positive associations with academic performance as well as attitude (Centers for Disease Control and Prevention, 2010).

Recently, an electronic physical activity intervention (FunDoRoo) was developed to promote physical activity in youth with and without disabilities. Outcomes of the intervention include body composition, motor proficiency, quality of life and physical activity self-efficacy (Rubin, Wilson, Wiersma, Weiss, & Rose, 2014). There are many benefits of physical activity, including cognitive functioning, especially for youth with disabilities.

**Benefits of Physical Activity on Cognition**

The relationship between physical activity and cognition has been highly studied in many different populations. Several studies suggest a positive relationship between physical activity and cognitive functioning (Asigbee, Whitney & Peterson, 2018;
Everhart, Dimon, Stone, Desmond & Casilio, 2012). Many researchers have suggested that physical activity can enhance academic performance as a result of the following physical activity outcomes: increased blood flow, enhanced mood, increased mental alertness and improvement in self-esteem (Bailey, 2006).

Academic behavior in children is equally as important as academic achievement in regards to success in the classroom. A recent study found a positive relationship between physical activity and academic behaviors of children. Academic behaviors are characterized by: on-task behavior, organization, planning, attendance, scheduling and impulse control (Sullivan, 2017). Additionally, researchers conducted a systematic review that found that academic behaviors were reportedly higher in children that had one or more daily recess periods of more than 15 minutes (Asigbee, Whitney, & Peterson, 2018).

The benefits of physical activity participation have been examined in a variety of ways. A recent meta-analytic review examined literature on the effects of chronic and acute physical activity on working memory performance in healthy participants. Acute bouts of physical activity are characterized by a single session with low to vigorous intensity. Chronic physical activity is characterized by low to vigorous sessions that occur more than once and are over a span of time. Overall, this study found physical activity to be associated with improvements in working memory performance after both, acute and chronic bouts of physical activity. (Rathore & Lom, 2017). Although there are several studies that focus on relationship between physical activity and cognition, there is limited research involving physical activity and cognition in individuals with disabilities.
CHAPTER THREE

MATERIALS AND METHODS

Upon approval from the Institutional Review Board, the current study employed a pretest-posttest quasi-experimental design to explore the impact of a physical activity program, FunDoRoo on cognitive function. More specifically, data related to the impact of acute and chronic physical activity on cognitive functioning in youth with disabilities was examined. The data was collected via the modified Corsi Block Test (PathSpan).

Participants

Participants in this study included individuals between ages eight and twenty-one who have at least one disability and who participated in the TRiPS program. Participants of this study had disabilities including: Down syndrome, autism spectrum disorder, intellectual disability, developmental delay and other health impairments (See). The current study focused on four of the ten TRiPS schools, including two primary schools and two high schools. Participants were students enrolled in the four schools that were selected for the study. Participants were selected based on their ability to independently complete the study assessments using an iPad along with parental permission to participate in the study and individual assent (See Appendix A).

Intervention

The FunDoRoo program was utilized to provide a physical activity intervention in youth with disabilities. FunDoRoo is an electronic application containing physical activity curriculum. It was developed and tested to improve motor skills of youth with and without developmental disabilities. There are 50 total lesson plans that progress in both
duration and difficulty. Each lesson plan indicates an estimated time as well as whether
the activity is best suited for bigger or smaller spaces. Each lesson plan includes three
components: Activities, Daily Plans and Tools (See Appendix C). The activities feature
is broken down into three categories: body preparation (warm-up), strengthening
(muscle and bone building), and games. Each activity also includes images and written
descriptions as well as demonstration videos. The videos provide step-by-step
instructions on how to set-up and carry out the activities. Each video is parent or
instructor led and includes a demonstration by youth with and without developmental
disabilities. Additionally, the tools feature includes tutorials on how to modify activities
and create individual plans. The content of FunDoRoo mobile application has been
submitted for copyright for intellectual property (FunDoRoo, 2018).

**Instrumentation**

Cognitive functioning was measured through an electronic assessment known as
PathSpan PathSpan is an electronic memory test and is an electronic version of the
Corsi Blocks psychological test. For this study, cognition was tested before and after a
FunDoRoo activity on the same day, known as an acute bout of physical activity. It was
also measured before and after the nine weeks of using the FunDoRoo program as a
physical activity intervention, known as chronic physical activity.

For the current study, selected students completed the electronic memory test
before and after a 30-minute session of physical activity. Within the program,
demographic information such as gender and age were collected and each participant
was given an identification code. Upon commencement of the test, the participants were
read instructions that read as follows: *Now we are going to play a copying game. You will see some buttons on the screen. The buttons are going to flash in a pattern. You watch the pattern. When it is done, you copy the pattern by touching the same buttons and then press the “Done” button to show that you are finished copying. Try and copy the pattern in the same order that you saw. I'll show you how to do it on the first one. Watch me watch the pattern and then copy it* (Hume, 2014, screenshots section, para. 1-3) (See Figure 3). Each trial consists of a sequence of lighted buttons displayed for the participants to memorize and replicate by touching the buttons in the same order. The length of each trial increases until the participant has gotten three trials in a row incorrect.

**Data Collection Procedures**

Data was collected prior to the implementation of the FunDoRoo program to establish a baseline as well as at the end of the eight-week program. Data were collected in six schools that participated in the TRiPS program. This consisted of two primary schools, two middle school classrooms, and two high schools. The researcher assessed the chronic impact of this program on cognitive outcomes (working memory, inhibition, sustained attention and self-regulation). Additionally, the acute impact of the program on cognition was assessed by collecting data on these variables before and after a FunDoRoo activity on the same day.

More specifically, the baseline assessments that were used to measure cognitive functioning occurred during the first week of the TRiPS program. Each student with a disability was pulled aside to a more secluded area of the classroom or was taken
outside of the classroom to complete the assessment. The researcher referred to the PathSpan cognitive assessment as a “game” when speaking with the students with disabilities. The researcher gained ascent by getting a head nod or verbal response when the student was asked if he or she wanted to play the game. It was then explained how to play the game. It was described to each student that the goal of the game was to tap each green dot that lit up, in the correct order. The researcher instructed each student to watch the pattern, and then wait for the noise before copying the pattern. Each student completed the PathSpan cognitive functioning test individually. If a student was not assessed on the first day, they had the opportunity to complete the tasks at a later date. The FunDoRoo program began during the third week of the TRiPS program. After approximately eight weeks of engaging in physical activity through the FunDoRoo program, data was collected again mimicking the procedure from the baseline assessment. In addition to collecting data to see the impact of chronic physical activity on cognition, the impact of an acute bout of physical activity was assessed by collecting data before and after a FunDoRoo activity on the same day at the midpoint of the TRiPS semester.

**Data Analysis Procedures**

The iPads that were used for the PathSpan assessment were stored in a locked filing cabinet in the researcher’s office then downloaded into spreadsheet on a password-protected computer. Next, it was converted into the Statistical Package for Social Sciences (SPSS) Version 24. The researcher used the PathSpan data results to examine changes in cognition that occurred from when the baseline data
was collected to the mid-point of the FunDoRoo program. More specifically, data was compared from the baseline data to the data that was collected before and after a FunDoRoo protocol during the mid-point data collection. Additionally, data was also examined to see if there were changes in the tasks that were performed before and after engaging in 30 minute FunDoRoo session on one day. The data analyzed based on how many individual taps each student matched correctly as well as how many trials each student successfully completed. A successful trial was characterized by matching the entire pattern correctly. Analysis of data included a paired sampled t-test for pre and posttests for chronic physical activity as well as pre and posttests for the acute bout of physical activity.
CHAPTER FOUR

THE IMPACT OF PHYSICAL ACTIVITY ON COGNITION IN YOUTH WITH DISABILITIES

Abstract

The purpose of this study is to determine the impact of physical activity on cognition in youth with disabilities. This study is in collaboration with the TRiPS (Therapeutic Recreation in Public Schools) program at the University of Tennessee. Project TRiPS is a service-learning course where, paired with in-class instruction, students implement therapeutic recreation services in special education classrooms with the intention of deriving specific outcomes. More specifically, thirty-minute physical activity interventions were implemented during each TRiPS session using an intervention protocol called FunDoRoo. A pretest posttest quasi-experimental design was used to explore the impact of the physical activity on students’ cognition. Data related to the impact of acute and chronic physical activity on cognitive functioning in youth with disabilities was collected via the modified Corsi Block Test (PathSpan).

Introduction

Therapeutic Recreation is a health care profession that focuses on the use of recreation and leisure to enhance the quality of life among individuals with deficits of any kind (Green et al., 2018). Services provided by recreation therapists include goal-oriented activities that focus on increasing at least one of the following areas: cognitive functioning, physical activity, spirituality, emotional wellbeing, and social interaction (American Therapeutic Recreation Association [ATRA], n.d.), Therapeutic Recreation
services are provided by Certified Therapeutic Recreation Specialists (CTRS). A CTRS evaluates an individual’s functional levels through various assessments to create treatment plans that increase functioning one or more of the following areas of cognition, physical ability, social development and emotional wellbeing. Therapeutic recreation services are offered in a variety of settings that include, but are not limited to the following: school systems, hospitals, mental health facilities, skilled nursing facilities, and community programs (Bureau of Labor Statistics, n.d.). Therapeutic recreation services within school systems are designed to provide opportunities that can enhance various skillsets across multiple domains for individuals with disabilities. Specifically, a CTRS can play a crucial role in increasing skills required for physical activities. A CTRS in a school also focus’s on enhancing the quality of physical activity that students with disabilities are receiving by training educators, recreational personnel and even family members (Etzel-Wise & Mears, 2004). Many Recreation Therapists have recently stressed the importance of incorporating physical activity and exercise into practice (Kasser & Lytle, 2015).

Physical activity and exercise is extremely beneficial for overall health. Several studies on physical activity have examined beneficial outcomes, such as improvement in cognitive function. More specifically, the relationship between physical activity and cognition has been further explored in individuals with disabilities and suggest a positive relationship (Alesi et al., 2014). Additionally, a recent systematic review examined the effect of physical activity on cognitive performance in youth with Down syndrome. This examined the effects of acute and chronic physical activity and suggested positive
outcomes from both. Acute bouts of physical activity were described as physiological changes that occurred after a single session of physical activity and chronic was defined as changes after repeated sessions of physical activity (Nocera, Wozencroft, & Coe, 2019). Furthermore, this review suggested that Recreation Therapists utilize physical activity to enhance outcomes of their programs.

Although research on physical activity and cognition is limited, similar studies have shown positive influences on cognitive function and physical activity. A recent, related study focused on primary grade students and intermediate elementary grade students with intellectual disabilities engaging in daily physical activity protocols prior to engaging in academic work. Improvement in academic work was shown in both language arts and mathematics for the intermediate elementary grade students, but the results of the primary grade students were inconsistent (Brett et al., 2012). While preliminary work has been done in this area it only begins to address the relationship between physical activity and cognition. Additional research is needed to further examine the impact of physical activity on cognition and academic performance and this study seeks to address this need. The purpose of this research is to determine if cognitive functioning is impacted by physical activity in youth with disabilities. Two specific aims of this study include: 1) examining the impact of an acute bout of physical activity on cognitive function in youth with disabilities and 2) examine the impact of chronic physical activity on cognitive function in youth with disabilities.
Literature Review

Therapeutic Recreation in Public Schools Program

Therapeutic Recreation in Public Schools, also known as Project TRiPS, is one unique aspect of the Therapeutic Recreation curriculum at the University of Tennessee. Through this program, undergraduate and graduate students from the University of Tennessee are assigned to two of the nine Comprehensive Development Classrooms within Knox and Sevier County that has agreed to partner with the University of Tennessee. Upon the first visitation of the TRiPS program, college students are paired 1:1 or 1:2 with students with disabilities. The teachers of the Comprehensive Development Classroom provide the college students with the goals and objectives from the Individualized Education Plan (IEP) of each student with a disability. Through observation and documentation, the college students are able to evaluate any progress made on the goal(s) they were working on during the TRiPS sessions. Additionally, through Project TRiPS, college students have the opportunity to implement one hour of therapeutic recreation activities each session. This program is designed to teach college students the role of a practicing Certified Therapeutic Recreation Specialist and gain knowledge of and experience with assessment tools, developing lesson plans, facilitating therapeutic activities and the documentation process.

Benefits of Therapeutic Recreation in Public Schools

Students can benefit from school-based recreational therapy services in the following areas: increased self-esteem and confidence, increased knowledge of leisure and leisure resources, increased functional abilities, enhanced social skills, enhanced
emotional stability, improvement in academic work (Etzel-Wise & Mears, 2004). Within
the school setting, a CTRS works collaboratively with classroom teachers, adapted
physical education teachers, occupational therapists, physical therapists and speech
and language pathologists. A recreation therapist plays a significant role with the
school, community, and family (Etzel-Wise & Mears, 2004; Bambara, Browder, & Koger,
2006; Browder & Cooper, 2001; Kleinert, Miracle, & Sheppard-Jones, 2007; Rynders &
Schlein, 1993; Waller & Wozencroft, 2010). There are many beneficial outcomes of
therapeutic recreation in schools including the enhancement of social, recreational, and
behavioral skills (Waller & Wozencroft, 2010). Engagement in recreation activities is
also beneficial to many health factors in youth with disabilities. It is crucial for recreation
therapists’ to enhance recreation and leisure opportunities for students with disabilities
due to the lack of available opportunities. Youth with disabilities are more likely to
develop more health problems and have a greater risk of obesity because of the limited
opportunities to participate in recreation and leisure (Green et al., 2017). Research has
shown that regular activity may overall improve physical fitness in youth and
adolescents with disabilities (e.g. Murphy & Carborne, 2008).

**Benefits of Physical Activity in Public Schools**

There are numerous benefits of physical education and physical activity
participation for school-age children. In general, physical activity benefits for children
include improvement in strength and endurance, building healthy bones and muscles,
controlling weight and normalizing blood pressure and cholesterol (Green et al., 2018).
Studies focused on physical education claim that benefits include enhanced
development of mind and body, self-confidence, social and cognitive development, and academic achievement (Bailey, 2006).

For many children, school systems are the main source of physical activity opportunities. It is extremely important for children to develop basic movement skills through physical activity participation to set a foundation for the continuation and progression of physical activity. Studies have shown that children that do not acquire an adequate base of movement skills are more likely to be excluded from participation in organized sports and play experiences (Bailey, 2006).

A recent study focused on an electronic physical activity intervention (FunDoRoo). This intervention was developed to promote physical activity in youth with and without disabilities. Outcomes of the intervention include body composition, motor proficiency, quality of life and physical activity self-efficacy (Rubin, Wilson, Wiersma, Weiss, & Rose, 2014). There are many benefits of physical activity, including cognitive functioning, especially for youth with disabilities.

**Benefits of Physical Activity on Cognition**

Academic behavior in children is equally as important as academic achievement in regards to success in the classroom. A recent study found a positive relationship between physical activity and academic behaviors of children. Academic behaviors are characterized by on-task behavior, organization, planning, attendance, scheduling and impulse control (Sullivan, 2017). Additionally, researchers conducted a systematic review that found that academic behaviors were reportedly higher in children that had
one or more daily recess periods of more than 15 minutes (Asigbee, Whitney, & Peterson, 2018).

The benefits of physical activity participation have been examined in a variety of ways. A recent meta-analytic review examined literature on the effects of chronic and acute physical activity on working memory performance in healthy participants. Acute bouts of physical activity are characterized by a single session with low to vigorous intensity. Chronic physical activity is characterized by low to vigorous sessions that occur more than once and are over a span of time. Overall, this study found physical activity to be associated with improvements in working memory performance after both, acute and chronic physical activity. (Rathore & Lom, 2017). Although there are several studies that focus on relationship between physical activity and cognition, there is limited research involving physical activity and cognition in individuals with disabilities.

Methods

Upon approval from the Institutional Review Board, the current study employed a pretest posttest quasi-experimental design to explore the impact of a physical activity program, FunDoRoo. More specifically, data related to the impact of acute and chronic physical activity on cognitive functioning in youth with disabilities was examined. The data were collected via the modified Corsi Block Test (PathSpan).

Participants

Participants in this study included fourteen individuals between ages eight and twenty-one who have at least one disability and who participated in the TRiPS program. Data was collected on twelve males and two female. The average age for the
participants of the study was 13.41. All participants of this study had at least one
disability such as: Down syndrome, autism spectrum disorder, intellectual disability,
developmental delay and other health impairments (See Table 1 for details). The
current study focused on four of the ten schools that participated in TRiPS the program,
including two primary schools and two high schools. These schools were selected
based on the location requirements within the IRB. Originally, there were two middle
schools in the study, but they were excluded due to unusable data. Participants of the
study were students enrolled a comprehensive development classroom within the four
schools selected. Participants were selected based on their ability to independently
complete the electronic assessments. Additionally, participants in the study were
required to have parental permission as well as individual assent. Permission forms
were sent home with all students before the study began (See Appendix A).

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age</th>
<th>Gender</th>
<th>Primary Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>Male</td>
<td>Developmental Delay</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Male</td>
<td>Down Syndrome</td>
</tr>
<tr>
<td>3</td>
<td>19</td>
<td>Male</td>
<td>Down Syndrome</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>Male</td>
<td>Down Syndrome</td>
</tr>
<tr>
<td>5</td>
<td>19</td>
<td>Male</td>
<td>Intellectual Disability</td>
</tr>
<tr>
<td>6</td>
<td>21</td>
<td>Male</td>
<td>Down Syndrome</td>
</tr>
<tr>
<td>7</td>
<td>19</td>
<td>Male</td>
<td>Autism</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Female</td>
<td>Intellectual Disability</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>Male</td>
<td>Other Health Impairment</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>Male</td>
<td>Autism</td>
</tr>
<tr>
<td>11</td>
<td>8</td>
<td>Male</td>
<td>Learning Disability</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
<td>Male</td>
<td>Developmental Delay</td>
</tr>
<tr>
<td>13</td>
<td>20</td>
<td>Female</td>
<td>Down Syndrome</td>
</tr>
<tr>
<td>14</td>
<td>20</td>
<td>Male</td>
<td>Autism</td>
</tr>
</tbody>
</table>
Intervention

The FunDoRoo program was utilized to determine whether physical activity impacted cognitive function in youth with disabilities. FunDoRoo is an electronic application containing physical activity curriculum. It was developed and tested to improve motor skills of youth with and without developmental disabilities. There are 50 total lesson plans that progress in both duration and difficulty. Each lesson plan indicates an estimated time as well as whether the activity is best suited for bigger or smaller spaces. Each lesson plan includes three components: Activities, Daily Plans and Tools (See Appendix C). The activities feature is divided into three categories: body preparation (warm-up), strengthening (muscle and bone building), and games. Each activity also includes images and written descriptions as well as demonstration videos. The videos provide step-by-step instructions on how to set-up and carry out the activities. Each video is parent or instructor led and includes a demonstration by youth with and without developmental disabilities. Additionally, the tools feature includes tutorials on how to modify activities and create individual plans. The content of FunDoRoo mobile application has been submitted for copyright for intellectual property (FunDoRoo, 2018).

The FunDoRoo activities were implemented in the TRiPS classrooms once a week for eight weeks. Each activity lasted for at least thirty minutes. The week prior to implementation, the researcher explained each activity to the college students. During this explanation, the researcher described each part of the activity and showed the
video of the activity. This time allowed the college students to ask questions and pick up any supplies needed for the activity.

**Instrumentation**

Cognitive functioning was measured through an electronic assessment known as PathSpan. PathSpan is a tool that has been used in related studies to measure cognitive functioning in children. For example, a laptop version of PathSpan was used to measure the visual-spatial working memory of over 500 children in a study at Carleton University (LeFevre et al., 2010). For the current study, cognitive functioning was tested before and after a FunDoRoo activity on the same day, known as an acute bout of physical activity. It was also measured before and after the nine weeks of using the FunDoRoo program as a physical activity intervention, known as a chronic physical activity.

PathSpan is an electronic memory test and is an electronic version of the Corsi Blocks psychological test (See Figure 1). It is a visual-spatial memory test that was designed for all ages to measure short-term memory span (Hume, 2014). This iPad program has been used in a study regarding performance and relations to early math abilities in children as well as in a study that focused on longitudinal predictors of mathematical performance (LeFevre et al., 2010). For the current study, selected students completed the electronic memory test before and after a 30-minute session of physical activity. Within the program, demographic information such as gender and age were collected and each participant was given an identification code (See Figure 2). Upon commencement of the test, the participants were given instructions that read as
follows: Now we are going to play a copying game. You will see some buttons on the screen. The buttons are going to flash in a pattern. You watch the pattern. When it is done, you copy the pattern by touching the same buttons and then press the “Done” button to show that you are finished copying. Try and copy the pattern in the same order that you saw. I’ll show you how to do it on the first one. Watch me watch the pattern and then copy it (Hume, 2014, screenshots section, para. 1-3) (See Figure 3). Each trial consists of a sequence of lighted buttons displayed for the participants to memorize and replicate by touching the buttons in the same order. The length of each trial increases until the participant got three trials in a row incorrect.

Figure 1. PathSpan: The Electronic Corsi Blocks Memory Test

Figure 2. PathSpan: Collection of Demographic Information

Now we are going to play a COPYING game. You will see some buttons on the screen. The buttons are going to flash in a pattern.

You watch the pattern. When it is done, you copy the pattern by touching the same buttons and then press the "Done" button to show that you are finished copying. Try and copy the pattern in the same order that you saw.

I'll show you how to do it on the first one. Watch me watch the pattern and then copy it.

Figure 3: PathSpan: Written Instructions

Data Collection Procedures

Data were collected prior to the implementation of the Fundoroo program to establish a baseline as well as at the end of the eight-week program. The baseline data represents each participant cognitive functioning level before the physical activity intervention began. The researcher assessed the chronic impact cognitive outcomes (working memory, inhibition, sustained attention and self-regulation) by comparing the baseline data to the data that were collected after several weeks of engaging in physical activity. Additionally, the acute impact of the program on cognition was assessed by collecting data on the students with disabilities before and after engaging in a Fundoroo activity on the same day.

More specifically, the baseline assessments that were used to measure cognitive functioning occurred during the first week of the TRiPS program. This is a week that is designed for the college students to get to know the students with disabilities. There were no planned activities for this week. The researcher attempted to pull each student with a disability aside to a secluded area of the classroom or take him or her outside of the classroom to complete the assessment. The researcher referred to the PathSpan cognitive assessment as a “game” when speaking with the students with disabilities. The researcher gained ascent by getting a head nod or verbal response when the student was asked if he or she wanted to play the game. It was then explained how to play the game. It was described to each student that the goal of the game was to tap each green dot that lit up, in the correct order. The researcher instructed each student to watch the pattern, and then wait for the noise before copying the pattern. Each
student completed the PathSpan cognitive functioning test individually. If a student was not assessed on the first day, they had the opportunity to complete the assessment at a later date. The FunDoRoo program began during the third week of the TRiPS program. After approximately eight weeks of engaging in physical activity through the FunDoRoo program, data was collected again mimicking the procedure from the baseline assessment. In addition to collecting data to see the impact of chronic physical activity on cognition, the impact of an acute bout of physical activity was assessed by collecting data before and after a Fundoroo activity on the same day at the midpoint of the TRiPS semester.

**Data Analysis Procedures**

Data from the PathSpan program was stored in an excel document with each participants’ identification code. Next, it was converted into the Statistical Package for Social Sciences (SPSS) Version 24. The researcher used the PathSpan data results to examine changes in cognition that occurred from when the baseline data was collected to the mid-point of the FunDoRoo program. More specifically, data was compared from the baseline data to the data that was collected before and after a FundDoRoo protocol during the mid-point data collection. Additionally, data was also examined to see if there were changes in the tasks that were performed before and after engaging in 30 minute FunDoRoo session on one day. The data analyzed based on how many individual taps each student matched correctly as well as how many trials each student successfully completed. A successful trial was characterized by matching the entire pattern correctly.
Analysis of data included a paired sampled t-test for pre and posttests for chronic physical activity as well as pre and posttests for the acute bout of physical activity.

**Results**

**Acute Bouts of Physical Activity**

Data were analyzed to determine the difference in taps and trials from the chronic pretest to acute posttest as well as from the acute pretest to the acute posttest. A correct tap is simply correctly matching one part of the entire pattern. A correct trial occurred if the student matched the entire pattern correctly. The amount of correct taps and trials varied for each participant (See Table 2).

A paired-samples t-test was conducted to evaluate the impact of an acute bout of physical activity on cognitive functioning in students with disabilities at the elementary and high school level. Data were collected on middle school students, but excluded from the study due to the lack of consent forms. Overall, there was no significant difference shown in the number of correct taps from pre to post FunDoRoo activity (acute) ($M=1.31$ $SD=21.11$, $p=0.82$). There was also no difference shown in the correct number of trials from pre to post of a FunDoRoo Activity ($M=-4.02$ $SD=16.63$, $p=0.401$) (See Table 3).
Table 2. Chronic & Acute Comparison of Correct Taps and Trials

<table>
<thead>
<tr>
<th>Participant</th>
<th>Correct Taps</th>
<th>Correct Trial</th>
<th>Correct Taps</th>
<th>Correct Trial</th>
<th>Correct Taps</th>
<th>Correct Trial</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1</td>
<td>22</td>
<td>6</td>
<td>22</td>
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<td>1</td>
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</tr>
<tr>
<td>11</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>5</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>25</td>
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<td>8</td>
<td>32</td>
<td>8</td>
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</tr>
<tr>
<td>14</td>
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<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

More specifically, there was no significant difference in the number of correct taps between the acute pretest and the acute posttest for the elementary-age students (M=-2.39 SD=11.01, p=0.561) or the number of correct trials between the acute pretest and the acute posttest (M=-1.21, SD=2.79 p=0.296) as seen in Table 1. There was also no significant difference in correct taps for the high school-age students (M=0.14 SD=31.31, p=0.992) or the number of correct trials between the acute pretest and the acute posttest (M=-7.29 SD=25.12, p=0.509). See Table 1 for more details. The paired samples statistics were also analyzed among elementary and high school-age students to compare the mean scores of each pretest/posttest comparison. Although there was no statistically significant difference from the PathSpan assessments, it is believed that there is practical significance within these results. There was an overall increase of the mean for each pretest/posttest comparison (See Table 4).
Chronic Physical Activity

Additionally, a paired-samples t-test was conducted to evaluate the impact of a chronic physical activity on cognitive functioning in students with disabilities at the elementary and high school level. Again, data was collected on middle school students, but excluded from the study due to the lack of consent forms. Overall, there was no difference shown in the number of correct taps from the baseline data to post FunDoRoo activity (chronic) (M= -5.45 SD=27.93, p=0.478). There was also no difference shown in the correct number of trials from baseline to post FunDoRoo Activity (M= -10.77 SD=26.25, p=0.165). See Table 2 for more details.

Additionally, there was no significant difference in the number of correct taps between the baseline data and the acute posttest for the elementary-age students (M= -0.19 SD=25.6, p =0.983 two-tailed) or the number of correct trials between the baseline and the chronic posttest (M= -11.13, SD=26.13, p =0.296 two-tailed) as seen in Table 3. There was also no significant difference in correct taps for the high school-age students (M= -12.46 SD=31.76, p=0.381) or the number of correct trials between the baseline data and the chronic posttest (M= -10.35 SD=28.89, p=0.421). See Table 3 for more details. The paired samples statistics were also analyzed among elementary and high school-age students to compare the mean scores of each pretest/posttest comparison. Although there was no statistically significant difference from the PathSpan assessments, it is believed that there is practical significance within these results. There was an overall increase of the mean for each pretest/posttest comparison (See Table 4).
Table 3. Mean Differences in Cognitive Function from Acute and Chronic Physical Activity (FunDoRoo) for Elementary and High School Students With Disabilities

<table>
<thead>
<tr>
<th>Paired Sample (Pre-Post)</th>
<th>Elementary-Age Students</th>
<th>High School-Age Students</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Differences (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Sig (2-Tailed)</td>
</tr>
<tr>
<td>Individual Taps</td>
<td>2.39</td>
<td>11.01</td>
<td>0.561</td>
</tr>
<tr>
<td>Complete Trial</td>
<td>-1.21</td>
<td>2.79</td>
<td>0.296</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Paired Sample (Pre-Post)</th>
<th>Elementary-Age Students</th>
<th>High School-Age Students</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Differences (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Sig (2-Tailed)</td>
</tr>
<tr>
<td>Individual Taps</td>
<td>-0.19</td>
<td>25.6</td>
<td>0.983</td>
</tr>
<tr>
<td>Complete Trial</td>
<td>-11.13</td>
<td>26.13</td>
<td>0.302</td>
</tr>
</tbody>
</table>
# Table 4. Differences in Cognitive Function from Acute and Chronic Physical Activity (FunDoRoo)

## Acute (Pre- to Post FunDoRoo Activity)

<table>
<thead>
<tr>
<th>Comparison Group</th>
<th>Elementary-Age Students</th>
<th>High School-Age Students</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean-Pre</td>
<td>SD</td>
<td>Mean-Post</td>
</tr>
<tr>
<td>Individual Taps (% correct)</td>
<td>21.23</td>
<td>27.82</td>
<td>18.84</td>
</tr>
<tr>
<td>Complete Trial (% correct)</td>
<td>17.72</td>
<td>30.26</td>
<td>18.93</td>
</tr>
</tbody>
</table>

## Chronic (Baseline to Post FunDoRoo Activity)

<table>
<thead>
<tr>
<th>Comparison Group</th>
<th>Elementary-Age Students</th>
<th>High School-Age Students</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean-Pre</td>
<td>SD</td>
<td>Mean-Post</td>
</tr>
<tr>
<td>Individual Taps (% correct)</td>
<td>18.64</td>
<td>25.64</td>
<td>18.84</td>
</tr>
<tr>
<td>Complete Trial (% correct)</td>
<td>7.79</td>
<td>20.61</td>
<td>18.93</td>
</tr>
</tbody>
</table>
Discussion

The purpose of this study was to determine the impact of acute and chronic physical activity on cognition in youth with disabilities. As part of the TRiPS program, thirty-minute FunDoRoo activities were implemented in Comprehensive Development Classrooms once a week for 8 weeks. Cognition (working memory) was assessed via an electronic version of the Corsi Blocks psychological test, PathSpan. Improvement in the cognition assessment scores did occur, but not enough to show statistical significance. Although the assessment scores did not improve significantly, there may have been other unexamined areas that showed improvement, such as academic behaviors within the classroom. According to Sullivan (2017), physical activity has been suggested to be a positive influence on academic behaviors such as staying on task, impulse control, organization, planning and scheduling. These areas may have shown improvement, but were not assessed in this study.

Acute Bouts of Physical Activity

When examining a single FunDoRoo activity, there was no significant difference shown from pretest to posttest for both the elementary and high school-age students. However, there was slight improvement in the cognitive function scores in the high-school age students. Data from the high-school age students shows us that this intervention is a step in the right direction. The goal was to find mechanisms that improve cognition. This intervention has shown that physical activity may be a positive influence on cognition.
While there was no difference in cognition for the elementary-age students, it is plausible that although PathSpan has been validated in preschoolers, and all participants functioned at or above preschool level, this assessment may have not been the best platform for the participants in this study who all have some form of cognitive impairment. Due to inattentive behaviors and varying abilities to follow directions, the researcher believes a non-electronic task would have worked better, perhaps the original version of the Corsi Blocks memory test may be better suited for this population.

**Chronic Physical Activity**

Similar to the findings regarding the acute bout of physical activity, when looking at changes from the baseline data to the mid-point of the TRiPS program, there was also no significant difference shown from the pretest to posttest. There was however, an overall improvement in scores for both elementary and high school-age students at the posttest mark. The researcher believes this improvement is due to the participation in FunDoRoo activities. Literature has suggested positive relationships between physical activity, fitness, and cognition (Nocera, Wozencroft, & Coe, 2019). Furthermore, this improvement signifies that there was practical significance shown in the study. The researcher believes that significant differences would have been present if the FunDoRoo activities were implemented more than just once a week. A recent study that used FunDoRoo as a physical activity intervention for individuals with Prader-Wili Syndrome found physical activity benefits after implementing the curriculum four days a week for
six weeks (Ruben et al., 2014). It is possible that with increased exposure to physical activity interventions, students with disabilities’ cognition scores may have shown a greater difference.

**Practical Implications**

PathSpan was the cognitive functioning assessment used for this study. It is a tool that has been used to measure cognition in youth; however, after reflecting on the data collection process, it may not be the best tool for youth with disabilities. The researcher observed many of the youth making incorrect taps and trials because they would begin touching the iPad screen before the trial began. Also, some of the students with disabilities had trouble touching the iPad screen on their own due to lower fine motor skills. The researcher believes that an alternate version of the Corsi Blocks memory test would have provided different results. Specifically, a memory test where students physically tapped items instead of the use of an iPad would have been beneficial for this population. PathSpan requires the students to follow directions and use patience. Due to characteristics of the samples’ disabilities, many students in this study had trouble paying attention and maintaining their impulsivity. The inability to comprehend the directions may have influenced the results of the cognitive assessment. The directions state to watch the pattern, listen for the noise, and then correctly match the pattern. Many of the students with disabilities would watch the pattern then immediately attempt to repeat the pattern. Unfortunately,
when this occurred, the student would not get the tap or trial correct although they knew the correct answer.

Another influence on the cognitive assessment scores is the level of attentiveness of the study participants. Due to the nature of the disabilities within the sample, many of the students had trouble staying on task, resulting in failure to match the entire pattern correctly. Also, a major influence on the cognitive assessment is the amount of distractions that occurred during the administration of the test. Although efforts were made to conduct the PathSpan assessment in a quiet and isolated location, that was not the case in most classrooms. This was due to not having enough space or time in the classroom. This resulted in the researcher conducting the assessment within the classroom, during a TRiPS session.

Due to TRiPS being an experiential learning course, students were responsible for facilitating the FunDoRoo activities each week. The facilitators may have influenced the level of participation the students with disabilities had in the FunDoRoo activities. For most of the college students, this is their first time implementing activities for individuals with disabilities. Since this is a learning experience for college students, their abilities to motivate the students with disabilities to participate in the physical activities may have varied. It is also important to note that the college students were required to provide ways to adapt the activities to the various types and levels of disabilities in the students in each classroom. Participation in the activities may have been impeded if the
activities are not adapted in a manner than met the students with disabilities needs.

Limitations

Although every effort was made to be thorough, there were several limitations to this study. First, the study was limited to eight weeks. Having more weeks of the FunDoRoo intervention would have been beneficial to the study. Second, the amount of participants in the study was significantly lower than what the researcher had anticipated. Having a larger population size may have influenced the cognitive assessment findings. Third, the physical activity intervention required many modifications. Due to varying abilities and ages, the activities needed to be adapted to fit the specific needs within each of the classed. This resulted in varying participation levels among the students with disabilities. FunDoRoo is a physical activity intervention that was designed for a one to two players at a time. Consequently, these activities were implemented in classrooms with at least ten students. This made it difficult to ensure that the students with disabilities were engaging in the desired amount of physical activity (30 minutes). Due to challenges related to IRB approval, the researcher was not allowed to use accelerometers on youth. This resulted in not being able to identify the intensity of physical activity the students received. The researcher believes the activities to have been mostly at the moderate level, but was unable to provide evidence due to this limitation. Additionally, the PathSpan assessment itself may have had influence the results. The researcher believes that an
alternate tool may have been more effective in assessing changes in cognition in this population.

**Intervention Advantages and Challenges**

At the end of the academic semester, the researcher asked the college students to provide feedback on the FunDoRoo activities. They were asked to reflect on the implementation of the FunDoRoo protocols and provide examples of things that worked well, things that did not work well, as well as any other suggestions.

According to the college students, a common strategy that worked well when implementing the activities was to split the class into two teams and making the activity into a competition or relay. It was suggested to keep score on a whiteboard so the students with disabilities could see the score. Also, it was beneficial to implement the activities in a larger or outdoor space instead of inside the classroom. It was helpful to have the college students participate alongside the students with disabilities during the activities. Instead of using beanbags or playground balls for the activities, using rolled up socks worked better for this population. Another thing that worked well for the implementation of FunDoRoo was breaking down the activities into single instructions, giving multiple attempts, and acknowledging success and immediate feedback.

There were also aspects of the FunDoRoo activities that did not work well, and the college students provided examples of these as well as suggestions for improvement. First, the activities took longer than anticipated, which resulted in
having to end some of the activities early. A common comment from the students was that there was not enough space in the classroom for the activities, so it was suggested to communicate with the teacher of the Comprehensive Development Classroom to get permission to use the gym or an alternate larger space. Also, for many of the activities, adaptations and modifications had to be made for students with limited mobility, flexibility, and rigidity. It was suggested to consider all disabilities and be prepared ahead of time for the modifications that will need to be made. Many college students thought the FunDoRoo activities were not appropriate for the high school-age students, specifically, the “Clean the Room” activity.

**Future Research**

Future research would benefit from a larger sample size, more participants, and more weeks of participation in the FunDoRoo program. A larger sample size could occur from collecting data in more of the TRiPS schools. This study specifically focused on six of the ten schools. More participants for the study would result from more consent forms being signed and returned. By doing this, there would be more data to analyze among the different age groups. Having more participants would allow the researcher to analyze the data more in depth. For example, breaking down the impact of physical activity by other demographic information. If this study were continued, it would be beneficial to collect data in more than the six classrooms that were selected for the study. Additionally, having more participants and more weeks of FunDoRoo activities,
may allow for better indicators of the impact of physical activity on cognition. This study took place during one academic semester that resulted in eight weeks of implementation. It would be extremely beneficial to conduct this study over a full school year. Future research would contribute to the literature on youth with disabilities as well as enhance existing literature on physical activity benefits in youth with disabilities.

**Conclusion**

This study utilized a physical activity intervention to examine the impact of physical activity on cognition in youth with disabilities. Although there was no statistical significance shown in the data, there was practical significance that makes this study informative and important. This study found evidence of some improvement in cognition after participation in FunDoRoo activities in both the elementary and high school-age students with disabilities. FunDoRoo could potentially be an intervention that would improve cognitive functioning and overall health; however, additional research is needed to support this notion. This study contributes to the literature pertaining to the benefits of the newly designed FunDoRoo program and physical activity in youth with disabilities. This study sought to increase the awareness of the impact that physical activity can have on cognition in youth with disabilities. This was a pilot study and additional research is warranted.
LIST OF REFERENCES


007-9057-0


Appendix A

Evaluation of the Project Therapeutic Recreation in Schools (TRIPS) Program
Parent Permission Form

Your child is invited to be part of a research study being conducted by Carlie Simms, Angela Wozencroft, Vincenzo Nocera, and Dawn Coe at the University of Tennessee, Knoxville. Your child is being invited because they have participated in the Therapeutic Recreation in Schools (TRIPS) Program. Being in this research study is voluntary, and you should only agree if you completely understand the study and want to volunteer to allow your child's data to be used. This form contains information that will help you decide if you want your child to be part of this research study or not. Please take the time to read it carefully, and if there is anything you don’t understand, please ask questions.

Purpose
The purpose of this study is to determine the effectiveness of TRIPS Program. We plan to publish articles and make presentations at conferences to share the results of this research.

Participation
If you choose to allow your child to participate and your child also agrees, we will analyze the data collected from your child during their time in the TRIPS Program. These data are from the following assessments:

- Measurement of height, weight, and waist circumference
- Physical activity assessment during the school day using an activity monitor
- Assessment of how well your child performs physical activities
- Assessments of cognitive function including a game similar to Simon on the iPad and an assessment similar to “Head, Shoulders, Knees and Toes”
- An assessment of how good your child feels they are at performing physical activities

Because these are all things that are part of their regular activities in the TRIPS Program, participation in the research will not require any additional time.

Benefit
Your child will not receive any direct benefit from allowing their data to be used in the research project, but we hope to learn things that will benefit participants of the TRIPS Program in the future.

Risks
This research is considered to be no more than minimal risk, which means there is no more expected risk to you than what your child might experience during a typical day. There is the risk of possible loss of confidentiality, as someone could find out your child was in the study or see their study information, but we believe that risk is unlikely because of the procedures we will use to protect their information.

Confidentiality
If you and your child agree to participate in the research, we will assign your child a unique identification number and use that instead of their name on all of the materials before we begin analyzing them for the research study. These materials will be stored in a secure location on the UT campus. No information which could identify your child will be shared in publications and presentations about this study.

Future Research
Your child’s data will not be used or shared with other researchers for future research, even if identifiers are removed.

IRB NUMBER: UTK IRB-18-04668 XP
IRB APPROVAL DATE: 09/20/2018
IRB EXPIRATION DATE: 09/19/2019
Evaluation of the Project Therapeutic Recreation in Schools (TRIPS) Program
Parent Permission Form

Your child is invited to be part of a research study being conducted by Carlie Simms, Angela Wozencroft, Vincenzo Nocera, and Dawn Coe at the University of Tennessee, Knoxville. Your child is being invited because they have participated in the Therapeutic Recreation in Schools (TRIPS) Program. Being in this research study is voluntary, and you should only agree if you completely understand the study and want to volunteer to allow your child’s data to be used. This form contains information that will help you decide if you want your child to be part of this research study or not. Please take the time to read it carefully, and if there is anything you don’t understand, please ask questions.

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Future Research
Your child’s data will not be used or shared with other researchers for future research, even if identifiers are removed.

IRB NUMBER: UTK IRB-18-04968-XP
IRB APPROVAL DATE: 09/20/2018
IRB EXPIRATION DATE: 09/19/2019
Appendix B

TRiPS Protocol Number ______

Name of TRiPS School: ____________________________________________

Date of TRiPS Session: ____________________________________________

Location of activity (gym, classroom, outside, etc.): ____________________

Duration of Get Ready Exercises: ________________________________

Duration of Get Strong Exercises: _________________________________

Duration of Game 1: ___________ Duration of Game 2: _____________

<table>
<thead>
<tr>
<th>Protocol Fidelity Checklist</th>
<th>Successfully Completed by Implementation Leader (Y or N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The instructor correctly set up the activity</td>
<td></td>
</tr>
<tr>
<td>The instructor correctly led all of the &quot;Get Ready Exercises &quot;</td>
<td></td>
</tr>
<tr>
<td>The instructor correctly led all of the &quot;Get Strong Exercises&quot;</td>
<td></td>
</tr>
<tr>
<td>The Instructor explained the instructions for the &quot;Games&quot; in a clear manner</td>
<td></td>
</tr>
<tr>
<td>The instructor physically demonstrated how to play the &quot;Game&quot;</td>
<td></td>
</tr>
<tr>
<td>The instructor provided directions on how to adapt the activities</td>
<td></td>
</tr>
<tr>
<td>The instructor provided performance feedback to the students e.g. &quot;you are doing that correctly&quot; or &quot;move this way&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Additional comments: ________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________

_________________________________________________________________
# Appendix C

**Plan 3**

**Activity Goal:** 10 - 30 min

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cone</td>
<td>2</td>
</tr>
<tr>
<td>Dome Cone</td>
<td>5</td>
</tr>
<tr>
<td>Hot Spot</td>
<td>6</td>
</tr>
<tr>
<td>Bean Bag Ball</td>
<td>2</td>
</tr>
<tr>
<td>Small Hoop</td>
<td>1</td>
</tr>
<tr>
<td>Large Hoop</td>
<td>2</td>
</tr>
</tbody>
</table>

## Get Ready

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm Swings</td>
<td>8 repetitions</td>
</tr>
<tr>
<td>Forward Jumps</td>
<td>1/2 lap</td>
</tr>
<tr>
<td>Arm Swings</td>
<td>8 repetitions</td>
</tr>
<tr>
<td>Forward Jumps</td>
<td>1/2 lap</td>
</tr>
<tr>
<td>Shoulder Rolls</td>
<td>8 repetitions (4 backward, 4 forward)</td>
</tr>
<tr>
<td>Exercise</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>High Knees</td>
<td>1/2 lap</td>
</tr>
<tr>
<td>Shoulder Rolls</td>
<td>8 repetitions (4 backward, 4 forward)</td>
</tr>
<tr>
<td>High Knees</td>
<td>1/2 lap</td>
</tr>
<tr>
<td>Half Jumping Jacks</td>
<td>6 repetitions</td>
</tr>
<tr>
<td>Frankenstein's</td>
<td>1/2 lap</td>
</tr>
<tr>
<td>Half Jumping Jacks</td>
<td>6 repetitions</td>
</tr>
<tr>
<td>Frankenstein's</td>
<td>1/2 lap</td>
</tr>
<tr>
<td><strong>GET STRONG</strong></td>
<td></td>
</tr>
<tr>
<td>Cone Press</td>
<td>8 repetitions</td>
</tr>
<tr>
<td>Push-up Plank</td>
<td>5 repetitions (on knees)</td>
</tr>
<tr>
<td>Cone Press</td>
<td>8 repetitions</td>
</tr>
<tr>
<td>Push-up Plank</td>
<td>5 repetitions (on knees)</td>
</tr>
<tr>
<td><strong>GAMES</strong></td>
<td></td>
</tr>
<tr>
<td>Make It, Take It*</td>
<td>3 rounds</td>
</tr>
<tr>
<td>Duck on a Rock</td>
<td>1 round</td>
</tr>
</tbody>
</table>
DUCK ON A ROCK

PLAYER 1

PLAYER 2

1 round
VITA

Carlie Simms was born in Nashville, Tennessee. She went to Donelson Christian Academy for High School. After graduation, she attended Tennessee Technological University for one year. Then, she transferred to the University of Tennessee, Knoxville where she completed her Bachelors of Science Degree in Therapeutic Recreation. Carlie decided to stay at the University of Tennessee for the Therapeutic Recreation graduate program. Prior to her first semester in graduate school, she was selected to be on the Therapeutic Recreation Grant Staff. This provided Carlie with the opportunity to be the Graduate Teaching Assistant and Co-Director for Camp Koinonia. During her second year, she stepped into the role of the very first Camp Koinonia Fellow. This position gave her the opportunity to focus on the work of Camp Koinonia for the entire year. Carlie will graduate in May 2019 with a Masters of Science in Therapeutic Recreation with plans to move to Nashville and work as a Certified Therapeutic Recreation Specialist.