Improving Fitness, Executive Function, and Competence of Children with Developmental Disabilities through an Adapted Gymnastics Intervention

by

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A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
August 04, 2018

Keywords: children, developmental disabilities, cerebral palsy, physical activity, community-based adapted programs

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ABSTRACT

Physical activity participation confers many physical and psychological benefits for all individuals with and without disabilities. Physical activity participation helps improve health-related fitness, psychological well-being, socialization, bone strength, independence performing daily activities, and competence. However, participation in physical activity from childhood to adolescence declines for both individuals with and without physical disabilities. Children with developmental disabilities participate in less physical activity than their typically developing peers have lower fitness levels, have lower motor competence, and experience difficulty performing fundamental movement skills. Without regular physical activity participation children with developmental disabilities are at risk for lower fitness levels, increased dependence performing daily activities, low self-esteem and decreased social acceptance. If children perceive physical activity to be fun and enjoyable, they are more likely to continue to participate as an adolescent and an adult.

Manuscript I examined the current literature to determine the factors that motivate children and adolescents with cerebral palsy and other physical disabilities to be physically active. These factors will be discussed with respect to function, family, fitness, fun, friends, and future proposed by Rosenbaum and Gorter (2012). Relevant articles to the systematic review from Academic Search Premiere, MEDLINE, PsycINFO, SPORTDiscus, and Education Research Complete was conducted. Titles and abstracts were reviewed for inclusion criteria. Ten

articles met inclusion based on the full text review and were categorized into five of the six contextual factors: function, family, fitness, fun, and friends. In regards to the 'F-word', future, clinicians, therapists, and researchers should consider the 'F-words' (i.e., function, family, fitness, fun) when developing programs and interventions for children and adolescents with physical disabilities.

Based on the results of Manuscript I, Manuscript II provided a sample lesson plan as part of an after-school program to help students with developmental disabilities improve fundamental movement skills and health-related physical fitness in a physical education class. The purpose of Manuscript II was to provide awareness to physical educators about the difference of fundamental movement skills and health-related physical fitness of elementary students with developmental disabilities. Physical competence in performing fundamental movement skills comes with repetition and practice. Students with developmental disabilities need additional time to develop these skills and competence when compared to their typically developing peers. The scenario in the article provided an after-school physical activity program for students with developmental disabilities, although the ultimate goal is for the activities provided for the students to be carried over to their physical education class. The lesson plan served as the bases for the intervention in Manuscript III.

Manuscript III examined longitudinal differences in health-related physical fitness, executive function, and perception of competence of five children (7-11 years) with developmental disabilities through an adapted gymnastics intervention that consisted of a fall 10-week (2x/week) and a spring 13-week (1x/week) follow-up. Longitudinal assessments were conducted at three time points (pre-test, post-test 1 and post-test 2). The results suggested no consistent time effects were found when considering all three time points together. However,

significant improvements in health-related fitness skills and cognitive flexibility between pre-test and post-test 1 were found. Improvements in perceived competence were observed between pre-test and post-test 2. Declines in performance were observed for select skills between post-test 1 and post-test 2. Improvements and maintenance of health-related physical fitness, cognitive function, and perceptions of competence following an adapted gymnastics intervention are affected by the number of sessions per week and types of activities available.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank God for making me the person I am, and this amazing opportunity! When people would ask what is the one thing you would change about yourself. I would always say I would take away my cerebral palsy because I do not like being different. I understand now that it is ok to be different from others, and experiencing life with cerebral palsy has given me a passion to help individuals with disabilities to participate in physical activity because of how it has helped me. God has been by my side the entire time during the pursuit of my Ph.D. He has been with me through the storms, and He will continue to be by my side as I step into the next chapter of my life.

I would like to thank the parents of the participants for my study. I want to thank them for bringing their children twice a week for 10-weeks as well as an additional 13-weeks. I could not have done the study without the participants or their wonderful families. I have enjoyed building relationships with each of the participants along the way as well as their families. I hope to be able to continue to be a part of their lives and watch them succeed in all that they desire to accomplish.

I would also like to thank my family. These past three years have been trying times, I could not have done it without their love and support. Particularly, I want to thank my twin sister for all she has done for me while pursuing my Ph.D. Thank you for always being the calm to my storm, the positive reassurance, the hug that takes away the worries, and the smile that says you've got this and I am behind you 100%.

Thank you to my committee members, Dr. Brock and Dr. Miller, for your support and always being there when ever I had a question or needed help with something. Dr. Renner, thank you for being and taking the time to be my outside reader. I appreciate it more than you know.

Thank you Dr. Rudisill for accepting me into the Ph.D. program in the School of Kinesiology. Thank you for taking the chance on a girl who wanted nothing more than to get her Ph.D. to help individuals with disabilities to be more physically active. Dr. Pangelinan, thank you for taking me on as a student, mentoring/advising me these three years. Thank you believing in me and my adapted gymnastics program for children with developmental disabilities! I have learned a lot in research, writing, teaching, working with others, building a program, and about myself during this time. I would not trade this experience for anything.

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LIST OF ABBREVIATIONS

ASD	Autism Spectrum Disorder
CP	Cerebral Palsy
DCCS	Dimensional Change Card Sort
DS	Down syndrome
EF	Executive Function
ICF	International Classification of Functioning Health and Disability
MVPA	Moderate-to-Vigorous Physical Activity
PE	Physical Education
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PTA	Parent Teacher Association
WHO	World Health Organization

I. INTRODUCTION

Introduction

The prevalence of a child being diagnosed with one or more developmental disabilities in the U.S. is one in six (16.67%) (Boyle, Boulet, Schieve, Cohen, Blumberg, Yergin-Allsopp, Visser, & Kogan, 2011). The prevalence of common developmental disabilities varies: Down syndrome (DS) is estimated as 1 in 700 children born with DS every year in the U.S. (Parker, Mai, Canfield, Rickard, Wang, Meyer, Anderson, Mason, Collins, Kirby, & Correa, 2010; Aly & Abonour, 2016); Autism Spectrum Disorders (ASD) is estimated as 1 in 59 (Baio et al., 2018), and cerebral palsy (CP) is estimated as 2.6 per 1,000 children (Maenner, Blumberg, Kogan, Christensen, Yeargin-Allsopp, & Schieve, 2016). Each of these developmental disabilities is characterized by unique signs and symptoms. However, recent evidence suggests that each of these developmental disabilities affect movement, gait, and coordination (Aly & Abonour, 2016; Bandini, Gleason, Curtin, Lividini, Anderson, Cermak, Maslin & Must, 2013). The extent to which motor ability is impaired is a critical factor in independence in activities of daily living and participation in physical activity.

Physical activity levels are correlated with health-related quality of life in typically developing individuals (Bize, Johnson, & Plotnikoff, 2007) and those with disabilities (Durstine, Paiter, Franklin, Morgan, Pitetti, & Roberts, 2000). Thus, achieving the recommended physical activity levels during childhood is necessary for fostering good health-related quality of life across the lifespan. However, children with developmental disabilities often do not achieve the

same levels of physical activity as their typically developing peers. For example, Whitt-Glover, O'Neill, and Stettler (2006), found that children aged 3-10 years with DS engaged in less physical activity compared to their typically developing peers. Similarly, children with ASD were reported less likely to reach the daily moderate-to-vigorous physical activity (MVPA) levels compared to their typically developing peers (Bandini et al., 2013). And, children and adolescents with CP do not achieve daily healthy physical activity levels (Tollerz, Forslund, Olsson, Lidstrom, & Holmback, 2015). Without regular physical activity participation children with developmental disabilities are at risk for lower fitness levels, increased dependence performing daily activities, low self-esteem and decreased social acceptance (Murphy & Carbone, 2008).

Several factors that contribute to the low levels of physical activity participation observed in children with developmental disabilities include: low physical fitness, low motor competence, motor impairments, and fewer opportunities in the community (Collins & Staples, 2017). In addition, as mentioned above, deficits in gait, posture, motor skill development, muscular strength, and muscular endurance observed in children with DS may serve as a barrier for participation in sport and recreational activities that may decrease physical activity (Aly & Abonour, 2016). Similarly, children with CP report limited physical activity participation because of deficits in gross motor abilities (Bult, Verschuren, Jongmans, Lindeman, & Ketelaar, 2011; Imms, Reilly, Carlin, & Dodd, 2009; Verschuren, Wiart, Hermans, & Ketelaar, 2012; Palisano, Chiarello, Orlin, Oeffinger, Polansky, Maggs, Bagley, & Gorton, 2010) and fine motor abilities (Bult et al., 2013; Imms et al., 2009) as well as poorer overall motor competence (Shields, Loy, Murdoch, Taylor, & Dodd, 2007). In addition to motor coordination problems, children with ASD also exhibit problems with behavior, social skills, and communication, which

together can hinder the amount of time spent engaged in physical activity and participating in organized sports and recreation (Bandini et al., 2013).

Physical activity participation confers many physical and psychological benefits that may improve the quality of life and health for individuals with and without developmental disabilities (Murphy & Carbone, 2008). Physical activity participation helps improve health-related fitness, psychological well-being, socialization, bone strength, independence performing daily activities, and competence (Murphy & Carbone, 2008). Reciprocally, movement ability and motor competence are important for physical activity participation (Stodden, Goodway, Langendorfer, Roberton, Rudisill, Garcia, & Garcia, 2008). Health and fitness levels are maintained and improved via sustained bouts of physical activity (Hartman, Smith, Westendorp, & Visscher, 2015; Collins & Staples, 2017). If children perceive physical activity to be fun and enjoyable they are more likely to continue to participate as an adolescent and an adult (Cook, Frost, Twose, Wallman, Falk, Galea, Adkin, & Klentrou, 2015). Therefore, it is imperative to provide adaptive physical activity opportunities for children with developmental disabilities outside of the clinical setting and in the community (Cook et al., 2015). The American Academy of Pediatrics and the Council on Children with Disabilities stated the importance of increasing physical activity in children with disabilities and providing programs within the community to promote health, physical fitness and a lifetime of physical activity participation (Murphy & Carbone, 2008).

Recent research studies have employed community-based physical activity interventions for children with developmental disabilities to improve health-related physical fitness skills and competence (Collins & Staples, 2017; Cook et al., 2015; Haney, Messiah, Arheart, Hanson, Diego, Kardys, Kirwin, Nottage, Ramirez, Somarriba, & Binhack, 2014; Davis, Zhang & Hodson, 2011; Fragala-Pinkham, Haley, & Goodgold, 2006). For example, Cook et al. (2015)

created a 6-week gymnastics program (1 hr. 2 x week) at a local gymnastics facility for 5 participants with cerebral palsy. The program provided opportunities for children to participate in a typical gymnastics class after the intervention. Each participant improved in gymnastics skills, range of motion and functional motor performance. Collins and Staples (2017) created a 10-week community-based physical activity program for children with DS and ASD (1.5 hrs. 1 x week) that focused on fundamental movement skills to help improve health-related physical fitness. Participants improved in aerobic functioning (shuttle run), muscular strength and endurance (modified curl-ups and isometric push-up) following the 10-week physical activity program.

Beyond these improvements in functional motor ability and health related physical fitness, improvements in social skills/perceived competence were observed by Fernandez, Ziviani, Cuskelly, Colquhoun, & Jones (2018) in a circus themed community-based physical activity program for school-aged children with developmental disabilities. Similar improvements in cognitive function, particularly executive function (EF) (i.e., inhibition, attention, cognitive flexibility, and working memory) may result from adapted physical activity programs. For example, improvements in EF were observed after participation in physical activity interventions in typically developing children (Diamond & Ling, 2016). Moreover, improvements in EF are observed when children participate in sports that are cognitively challenging (Lakes & Hoyt, 2004). In order to see improvements, EFs need to continually be challenged (Diamond & Ling, 2016), and go beyond one's own competence level or comfort zone (Ericsson, Nandagopal, & Roring, 2009). However, no studies have examined improvements in EF in children with disabilities participating in adapted motor skill/sport intervention. Taken together, programs aimed at increasing health-related physical fitness and motor skills may confer important non-

motor benefits for those with developmental disabilities, particularly when they are cognitively challenging.

Providing physical activity programs within the community that are fun, feasible and accessible to improve health-related physical fitness, competence, and socialization for children with developmental disabilities is vital to promote lifelong participation in physical activity (Cook et al., 2015; Collins & Staples, 2017).

Statement of the Problem

Children and adolescents with developmental disabilities participate in less physical activity than their typically developing peers (Whitt-Glover et al., 2006; Bandini et al., 2013; Tollerz et al., 2015). Physical activity participation helps improve health-related fitness, psychological well-being, socialization, bone strength, independence performing daily activities, and competence (Murphy & Carbone, 2008). Without access to community-based adapted physical activity opportunities children are less likely to accumulate the many benefits physical activity offers. Beyond the motor and physical health benefits, few studies have examined the impact of adapted physical activity on non-motor functions (e.g., EF).

Purpose Statement

The purpose of this study was to quantify changes in health-related physical fitness, perceived competence and executive function of children with developmental disabilities following a 10-week (20 sessions) adapted gymnastics intervention and following a 13-week (13 sessions) follow-up. It was hypothesized that participants would improve health-related physical fitness and perceived competence after completing the intervention consistent with previous

studies. Moreover, we hypothesized that children with developmental disabilities would show increased executive function (i.e., inhibition, attention, and cognitive flexibility) following the intervention.

Significance of the Study

The few evidence-based community-based physical activity programs/interventions for children with developmental disabilities focus on the heath-related physical fitness aspects physical activity provides (Collins & Staples, 2017; Cook et al., 2015; Haney et al., 2014; Davis et al., 2011; Fragala-Pinkham et al., 2006). Physical activity confers social, emotional, and cognitive benefits to participants. This study not only examines the health-related physical fitness aspects but executive function (attention, inhibition, and cognitive flexibility) and perceived cognitive, physical, and social competence of the participants. The results of this study can be added to the small amount of literature on community-based physical activity programs for children with developmental disabilities to provide researchers, clinicians, educators, policy makers and parents a better understanding of the importance of physical activity participation.

Indeed, the next steps in this research are to promote physical activity participation and adherence among this population by incorporating more adapted or inclusive physical activity programs within communities or community-based interventions.

II. MANUSCRIPT I: A Systematic Review on Motivations of Children and Adolescents with Cerebral Palsy and Physical Disabilities to Participate in Physical Activity

Introduction

Physical activity participation confers many physical and psychological benefits for all individuals with and without disabilities (Murphy & Carbone, 2008). It reduces the risk of chronic health conditions, including obesity and diabetes, strengthens muscles and bones and improves cardiorespiratory fitness (World Health Organization, 2010). Physical activity participation also improves motor skill competence, facilitates interactions with peers, and is associated with improved mental health as well as psychological well-being (Danhan-Oliel, Shikako-Thomas, & Majnemer, 2012; Maher, Williams, Olds, & Lane, 2007). However, participation in physical activity from childhood to adolescence declines for both individuals with physical disabilities and typically developing individuals (Maher et al., 2007; Rimmer & Rowland, 2008; Law, King, King, Kertoy, Hurley, Rosenbaum, Young, & Hanna, 2006). Moreover, the long-term participation in physical activity to adulthood depends on activity levels during childhood and adolescence (Telema, Yang, Viikari, Valimaki, Wanne & Raitakari, 2005; Bjornson, Belza, Kartin, Logsdon, & McLaughlin, 2007). Therefore, it is critical to increase physical activity in children and adolescents, particularly those with physical disabilities to confer both short-term and long-term benefits on physical and mental health.

In order to encourage physical activity participation in children and adolescents the Council on Children with Disabilities Executive Committee of the American Academy of Pediatrics

encouraged health professionals to advocate that all children and adolescents including those with disabilities participate in more physical activity, organized sports, and recreation (Murphy & Carbone, 2008; Rimmer & Rowland, 2008). The World Health Organization (WHO) has provided global physical activity guidelines for children and adolescents with and without disabilities. The guidelines provide recommendations specific to different contexts (i.e., community, school, and family) to facilitate participation in daily physical activity, including recreational activities, planned exercise, physical education, play, sports, games, or transportation (World Health Organization, 2010).

The impact of a health condition on activity and participation is central to the World Health Organization's International Classification of Functioning Health and Disability (ICF) framework. In addition to impaired body structure and functions, characteristics of cerebral palsy (CP) and other physical disabilities affect physical activity (Rosenbaum & Gorter, 2012). Indeed, children with CP have lower daily physical activity levels than their typically developing peers (Zwier, van Schie, Becher, Smits, Gorter & Dallmeijer, 2010; Carlon, Taylor, Dodd, & Shields, 2013; Tollerz, Forslund, Olsson, Lidstrom, & Holmback, 2015). Similar disparities in physical activity levels are observed for adolescents with CP (Maher et al., 2007; Bjornson et al., 2007; Carlon et al., 2013; Majnemer, Shikako-Thomas, Schmitz, Shevell, & Lach, 2015; van Eck, Dallmeijer, Beckerman, van den Hoven, Voorman, & Becher, 2008). The intensity and duration of physical activity participation depends upon the individual's degree of gross motor (Maher et al., 2007; Bult, Verschuren, Jongmans, Lindeman, & Ketelaar, 2011; Imms, Reilly, Carlin, & Dodd, 2009; Verschuren, Wiart, Hermans, & Ketelaar, 2012; Palisano, Chiarello, Orlin, Oeffinger, Polansky, Maggs, Bagley, & Gorton, 2010) and fine motor impairments (Bult et al., 2011; Imms et al., 2009). But, in addition to impairments to body structure and function, other

factors contribute to the reduced physical activity participation of children and adolescents with CP and other physical disabilities. These factors include: personal factors, such as perceived competence (van Eck et al., 2008; Shields, Loy, Murdoch, Taylor, & Dodd, 2007) and age (Maher et al, 2007; Majnemer et al., 2015; van Eck et al., 2008; Bult et al., 2011; Palisano et al., 2010). Physical environmental factors such as accessibility (Bult et al., 2011; Verschuren et al., 2012) also serve as barriers for participation in physical activity. Moreover, social environmental factors such as family (Bult et al., 2011; Imms et al., 2009; Verschuren et al., 2012; Palisano et al., 2010; Willis, Girdler, Thompson, Rosenberg, Reid, & Elliott, 2017) peers (Bult et al., 2011; Imms et al., 2009; Verschuren et al., 2012; Powrie, Kolehmainen, Turpin, Ziviani, & Copley, 2015), and school (Bult et al., 2011; Imms et al., 2009; Verschuren et al., 2012) can affect physical activity participation. Thus, in order to increase physical activity participation in children and adolescents with CP and other physical disabilities as promoted by the American Academy of Pediatrics and the WHO, these various and interacting factors must be considered when developing programs and interventions.

In addition to identifying factors that hinder but promote physical activity participation, Rosenbaum and Gorter (Rosenbaum & Gorter, 2012) propose a conceptual framework that reframes physical activity with respect to factors that increase participation in children and adolescence with CP and other physical disabilities. The framework examines childhood disability through the lens of 6 'F-words' (function, family, fitness, fun, friends, and future). Importantly, this framework places an importance of fitness and physical activity as a health-promoting activity that goes beyond rehabilitation or therapy. This framework also examines motivating factors that promote life-long (future-oriented) physical activity engagement. Considering these motivating contextual factors, Rosenbaum and Gorter (Rosenbaum & Gorter,

2012) suggest that in order to develop function (i.e., achieve skills and task competence) in children and adolescents with physical disabilities, physical activity and fitness experiences must be fun, enhance friendships, and incorporate the family.

Objectives

The aim of this systematic review is to examine current literature to determine the factors that motivate children and adolescents with CP and other physical disabilities to be physically active. These factors will be discussed with respect to the six 'F-words' (function, family, fitness, fun, friends, and future) (Rosenbaum & Gorter, 2012).

Methods

Search Strategy

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009) a systematic review was conducted to examine the motivations for physical activity participation in children and adolescents with CP and other physical disabilities. The search strategy included the following terms: *cerebral palsy* OR *hemiplegia* OR *spasticity* OR *physical disabilities,* AND *child** OR *adolescent* OR *youth,* AND *physical activity* OR *exercise,* AND *motivation*.

The following electronic databases were queried: Academic Search Premiere, MEDLINE, PsycINFO, SPORTDiscus and Education Research Complete. The articles from each database were compiled using EndNote and prior to screening the articles, duplicates were identified and removed. Titles, abstracts, and full-text of the articles were reviewed for further inclusion (see Figure 2.1).

Eligibility Criteria

Inclusion criteria included: (1) articles published between 2007 and 2017; (2) articles published in an English-language peer-reviewed journal; (3) children and adolescents aged 5-18 years; (4) participants had a diagnosis of cerebral palsy or other physical disability (i.e., spina bifida, muscular dystrophy, acquired spinal cord injury, etc.); and (5) physical activity or exercise was examined in the study.

Data Collection Process

All article titles and abstracts were screened for inclusion by the first author. Articles that met the inclusion criteria based on the title/abstract review were then screened via full-text review by all three authors. Articles that met inclusion during the full-text review were categorized on the 'F-words' (function, family, fitness, fun, friends, and future). Table 2.2 includes the details for all of the studies that met inclusion following the full-text review.

Methodological Quality Assessment

Each article included in the review was also assessed for the quality of its methodology. Since this review included qualitative or non-experimental quantitative methodologies, the criteria to assess the internal validity of the study's overall quality, design, sample, measurement, and analyses was completed using the adapted criteria proposed by Imms (Imms, 2008). The rating scale ranges from 1-3 stars, where 1 represents the study not meeting criteria, 2 represents the study meets some evidence of criteria, and 3 represents the study meeting all criteria. Table 2.1 includes the criteria used to assess the overall quality of the qualitative studies (i.e., credibility, transferability, dependability, and confirmability) and internal validity of the non-

experimental quantitative methodologies (i.e., design, sample, measurement, and analyses). Table 2.2 summarizes the quality of each article included in the systematic review.

Analysis

The International Classification of Functioning, Disability, and Health (ICF), evaluates the health and function of those with disabilities (World Health Organization, 2013). The six concepts within the ICF framework include: health condition, body structure and function, activity, participation, environmental factors, and personal factors. Five of the six 'F-words' proposed by Rosenbaum and Gorter (Rosenbaum & Gorter, 2012) can be applied to the ICF framework to determine the motivations of children and adolescents with CP and other physical disabilities to participate in physical activities. For example, physical activity participation would have a profound impact on an individual with CP or physical disability (health condition), which in turn could affect the individual's function, family, fitness, friends, and future.

Each of the six 'F-words' proposed by Rosenbaum and Gorter (Rosenbaum & Gorter, 2012) were viewed in the present systematic review from the perspective of how it motivates a child with a physical disability to be physically active. Function can be considered physical activity or play. Family environment could include parents' perceptions of physical activity, interest in physical activity, etc. Fitness includes how physical activity affects fitness levels and activities of daily living. Fun includes how physical activities are perceived as fun or create enjoyable opportunities for individuals with disabilities. Friends are considered a social aspect of physical activity. Finally, future is used to consider the long-term impact of physical activity participation for children with CP and other physical disabilities.

Results

Figure 2.1 represents the PRISMA Flow Chart with details regarding the inclusion/exclusion of studies at each stage of review. The initial search of the databases yielded 93 articles for review with a total of 56 remaining once duplicates were removed. Twenty-five titles were excluded based on the title and abstract for the following reason: (11) therapeutic or rehabilitation (i.e., not aimed at physical activity or recreation; (5) population age; (7) non-physical disabilities (e.g., visual impairments, intellectual disabilities, deafness, etc.); and (2) review/protocol. Through the process of screening, 17 full-text articles met inclusion for full-text review. Seven articles were excluded after full-text review: (6) population, and (1) protocol for new approaches for exergames for individuals with physical limitations.

A total of 10 articles (see Table 2.2) met inclusion for the systematic review. Seven studies were qualitative, and three studies were non-experimental quantitative designs. All articles included in the present systematic review were published between the years of 2007-2017. The authors chose the range from 2007-2017 to conduct the systematic review to provide articles that were the most recent in the area of research. Across the 10 studies, a total of 242 participants were examined: 186 children and adolescents aged 5-18 years diagnosed with CP and 56 parents of children and adolescents diagnosed with CP or physical disability.

Qualitative Studies

A qualitative design was used by seven studies. Using the rating scale for methodological quality assessment by Imms (Imms, 2008), these studies were evaluated on a scale of 1-3 stars on each of the 4 criteria: credibility, transferability, dependability, and confirmability (see Tables 2.1 and 2.2). None of the studies received all three stars across the four criteria. With respect to

credibility, four of the studies received three stars. The authors of these studies either used triangulation, member checking, prolonged engagement during interviews or included all three in the study. Three studies reported limited evidence or unclear reporting of credibility or there was no prolonged engagement during interviews thus receiving two stars. Four studies received one or two stars for transferability. With respect for dependability, all seven studies received two or three stars. Lastly, with respect to confirmability, all but one study received three stars.

Quantitative Studies

Three studies used a quantitative design. The quantitative studies were rated on a scale of 1-3 stars based on the methodological quality, which includes: design, sample, measurement, and analysis. Among the three quantitative studies, two studies received three stars, the maximum rating for the methodological quality assessment across three criteria. These two studies examined a large sample in a specific population of participants with CP. Measurements used in both of these studies were validated as well as reliable. Statistical significance was reported across both studies. The third study received three stars for sample and measurement criteria. However, the third study received two out of three stars for analyses criteria because the clinical importance was not discussed. In addition, all three studies received two out of three stars for meeting some of the design qualifications. Two of the studies had designs appropriate to the research question for the study and both were cross sectional. The other quantitative study was not cross sectional nor used a comparison group, but the design was appropriate for the question. (See Tables 2.1 and 2.2).

Function

In four (Conchar et al., 2016; Knibbe et al., 2017; Lauruschkus et al., 2015; Li & Chen, 2012) of the 10 studies included in the review, participants discussed how body function and structure affected participation in physical activity. These studies reported difficulties in participating in competitive sports and activities that were skill-based due to the severity of the participants' motor limitations. These difficulties included: not performing the skills correctly, keeping up with peers, and fatigue or pain. Participants stated that physical activities were more motivating when the activity was adapted to their ability and motor functions.

Family

Eight (Columna et al., 2011; Conchar et al., 2016; Knibbe et al., 2017, Lauruschkus et al., 2015; Lauruschkus et al., 2017; Li & Chen, 2012; Majnemer et al., 2008; Sandlund et al., 2012) of the 10 studies discussed the role parents' play in physical activity participation. Participants enjoyed engaging in physical activity with their family and stated the importance of having their family as a support system when participating in activities. Support systems included help from extended family and transportation to allow family members to participate in physical activity together. Some participants also expressed a desire for greater autonomy in choosing in which activities they participated. Parents expressed the importance of physical activity because of the health benefits for the children, such as independence and socialization. Parents found it difficult for their children or the whole family to participate in physical activities due to parental stress, culture, educational status of parents, and receiving no support from others. Additional constraints reported by both parent and child in participating in physical activities included:

financial constraints, transportation, and a lack of available resources (e.g. a lack of programs, equipment and trained staff).

Fitness

Two (Conchar et al., 2016; Li & Chen, 2012) of the 10 articles discussed fitness in relation to physical activity. Participants in both studies expressed that participation in physical activity is important for health benefits. Participants voiced how they were motivated to participate in physical activity because it improves body composition by aiding in weight loss and staying fit. Physical activity also improved endurance, flexibility, strength, and agility, allowing the participants to be more independent and perform tasks more easily.

Fun

Six (Conchar et al., 2016; Knibbe et al., 2017; Lauruschkus et al., 2015; Li & Chen, 2012; Majnemer et al., 2008; Majnemer et al., 2009) out of the 10 studies examined the degree to which participants enjoyed participating in physical activity. Two of these studies were quantitative designs that described the physical activity preferences. The participants in these two studies rated recreational and social activities as the most enjoyable, compared to skill-based and self-improvement activities. Participants with more developed gross and fine motor skills were more likely to participate in active-physical activities, and participants with higher motivation were more likely to participate in skill-based activities. Four studies provided insights for reasons why the participants partake in physical activity. Participants expressed that participating in physical activity was fun and exciting, released tension, anger, stress and frustration, provided socialization with peers, and helped them gain competence in skills.

Friends

Six (Conchar et al., 2016; Knibbe et al., 2017; Lauruschkus et al., 2015; Li & Chen, 2012; Majnemer et al., 2009; Sandlund et al., 2011) out of the 10 studies explored how physical activity leads to opportunities for socialization. Participants reported they were motivated to engage in physical activities that involved being active with friends, being part of a team, gaining support from others, and interacting with others with similar motor difficulties. Compared to skill-based activities, adolescents with CP preferred activities that allowed for socialization with friends. However, some aspects of physical activity lead to negative social experiences. For example, participants reported that others stared or bullied them when performing a task in which he/she was not competent.

Future

None of the studies examined long-term changes in physical activity in children and adolescents with CP or other physical disabilities. However, based on the evidence regarding motivations for current engagement in physical activity, several factors described above are relevant. The participants' ability to choose the activity or engage in preferred activities, and have access to the activities that are adapted to meet the individual's abilities and motor functions will encourage long-term adherence. In addition, the benefit of long-term physical activity has been reported by participants and parents to carry over into other domains of function. Physical activity enhances long-term function via independence, opportunities for socialization, improved performance of daily activities, and the incorporation of other healthy behaviors.

Discussion

The ten studies evaluated in the present systematic review examined the factors that motivate children with CP and physical disabilities to be physically active. These motivations were considered with respect to the 'F-words' proposed by Rosenbaum and Gorter (Rosenbaum & Garter, 2012). Function, family, fitness, fun, friends, and future interact in a compelling way, and influence the participation in physical activities for children and adolescents with CP and physical disabilities.

With respect to function, compared to children with CP, adolescents with CP were less likely to participate in skill-based activities. Although participants across the studies desired to participate in more skilled-based activities, they felt limited due to their motor function abilities. To enhance participation in skill-based activities, teachers/facilitators must not focus on a 'normal' way of performing skills, (Rosenbaum & Gorter, 2012) but rather allow participants to perform skills appropriate for their abilities and structural constraints. Future studies or activity programs should provide opportunities for modifications or adaptations that may facilitate engagement particularly for adolescents with CP.

The family is a key source of support. Physical activity participation confers a benefit for all family members. Therefore, providing opportunities that include activities for the entire family that are accessible and feasible in the community is imperative.

With respect to fitness, the ability to independently perform motor skills and activities of daily living provides motivation for adolescents with CP or physical disabilities to improve one's fitness. Promoting improvements in fitness components, such as strength, flexibility and

endurance resulting from physical activity participation may be beneficial for sustained involvement.

With respect to fun and friends, inclusive positive environments that include friends would help reduce the negative perceptions of motor competence that may affect participation in children and adolescents with CP.

Many of these findings are consistent with previous reviews (Carlon et al., 2013; Willis et al., 2017; Powrie et al., 2015; Bloemen et al., 2014; Shakiko-Thomas et al., 2008). For example, other reviews identified age and fitness levels as factors that affect physical activity participation. Decreased physical activity participation observed from childhood to adolescence was related to perceptions of competence and function as well as a lack of opportunities. Fitness was a factor in two studies as a motivation among adolescents for participating in physical activity due to its physical health benefits particularly the ability to perform activities independently. Building strength and endurance as well as improving flexibility will likely help improve competence and motor functions to participate in physical activities as opportunities arise in the home, school, and community. The decline in physical activity participation among adolescents with physical disabilities needs to be addressed; promoting the health benefits of fitness during the transition from childhood to adolescence may help to attenuate this decline.

With respect to the future, policy makers should prioritize community- and school-based programs to provide children and adolescents with CP opportunities for physical activity outside the clinic. Inclusive programs with children and adolescents of all abilities promote social skills as well as overall well-being. Inclusive environments are those that allow equal opportunities for success and growth for individuals for all ability levels. These environments should help educate participants to be accepting and supportive of individual differences (Knibbe et al., 2017).

Moreover, inclusive environments should allow families and friends to participate with children and adolescents with CP and physical disabilities as these individuals provide emotional support that may lead to greater success.

Study Limitations

The present review was directed toward critical issues discussed by Rimmer (Rimmer & Rowland, 2008) and Murphy (Murphy & Carbone, 2008) regarding physical activity participation for children and adolescents with physical disabilities. This review focused on the recent literature between the years of 2007 and 2017, therefore relevant information before 2007 on motivations of children with CP and physical disabilities in terms of physical activity participation may have been excluded.

Only a small number of articles met inclusion. Thus, additional studies are needed to examine the motivations of adolescents with physical disabilities to engage in physical activity. Motivation was examined in several studies examining children with physical disabilities (e.g., fun, enjoyment, and friends). However, the motivations were different for adolescents (e.g., fitness and independence). Understanding these different periods of development and the motivations for physical activity engagement is important to initiate and develop sustained or long-term participation in physical activities. Long-term participation in physical activity is critical for the development of motor, social, and cognitive skills as well as health benefits into adulthood.

The study focused on CP and other physical disabilities and, as such, the perspectives and motivations of individuals with other disabilities have not been included. Similarities and differences across disabilities require further investigation and may be important for creating

inclusive interventions or physical activity programs in the community that include a diversity of disabilities.

Conclusion

This review examines the motivation for children with CP and physical disabilities to participate in physical activity with respect to the ICF framework and Rosenbaum and Gorter's theoretical model. Clinicians, therapists, and researchers should continue to consider these 'F-words' (i.e., function, family, fitness, fun, and friends) when developing programs and interventions for children and adolescents with physical disabilities as did a few researchers that created a gymnastics program for children with cerebral palsy that focused on function, fitness and friends (Cook, Frost, Falk, Adkin, Klentrou, Twose, Wallman, & Galea, 2015). Future research should evaluate how the differences in motivational climates may further influence short- and long-term adherence, motivation and wellness outcomes from physical activity in children and adolescents with physical disabilities.

Figure 2.1

PRISMA 2009 Flow Diagram

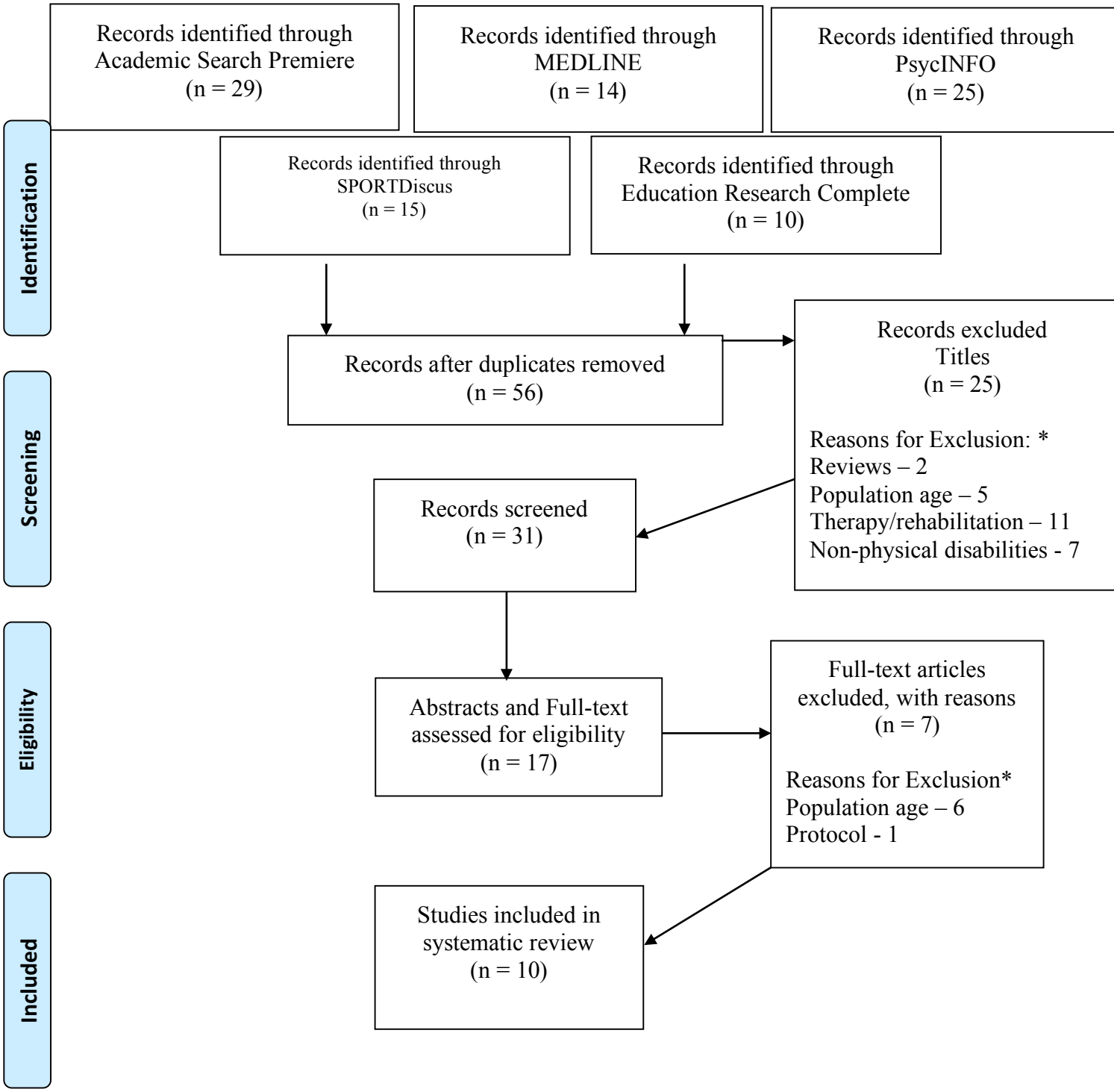

Table 2.1 Criteria for assessing the internal validity of qualitative and non-experimental quantitative methodologies of studies included in present systematic review. *Note: Criteria of Table 1 was adapted from Imms, 2008.

	Non-experimental Quantitative Research	Qualitative Research
Design	Appropriate for question Prospective rather than retrospective Cohort: +/- comparison group Cross sectional	
Sample	Selection bias reduced Population based Representative Convenient Size of study in relation to design & question (power) Clearly described participant characteristics	
Measurement	Measurement bias reduced Validity of tool for purpose Reliability of tool Recall/memory	
Analyses	Appropriate to research question & outcome measure Statistical significance Point estimates & variability provided Clinical importance discussed	
Overall Quality	Rigor Sample is representative or has comparison group Measure is valid for purpose & reliable Analyses are appropriate	Trustworthiness Credibility: prolonged engagement, triangulation, member checking Transferability: 'thick' description Dependability: consistency between data and findings Confirmability: peer/participant audit and/or checking of interpretations, reflective journal or other mechanism to manage potential cofounding of researcher perspective on outcome

Table 2.2 Summary of Articles included in Systematic Review. Summary includes the qualitative or quantitative quality and findings of each article.

First author (year)	Country	Design: focus	*n*	Diagnosis	Age	Measures	Quality	Findings
Majnemer (2008)	Canada	Cohort, survey	67	Cerebral palsy	Mean age = 9 years 7 months	CAPE	Design ** Sample*** Measure*** Analysis***	Children with CP participated in activities that were recreational, and social. The intensity level for participating in recreational activities w lower compared to a reference of typically developing children.
Majnemer (2009)	Canada	Population based survey	55	Cerebral palsy	6-12	CAPE PAC	Design ** Sample*** Measure*** Analysis***	Children aged 6-12 yea with cerebral palsy pref recreational and social activities instead of skilled-based and self-improvement activities. Physical activity preferences were predicted by motor limitations, age, and sex
Columna (2011)	United States	Qualitative: identify benefits, constraints, and strategies for participation in physical activity	12	Child diagnosed with physical, intellectual, or emotional disability	Adults	Personal data sheet Interviews	Credibility*** Transferability* Dependability*** Confirmability***	Three themes: (1) Individual and familial benefits; (2) Family constraints; (3) administrative constraints.
Sandlund (2011)	Sweden	Intervention	15	Cerebral palsy	6-16	Gaming diary SenseWear Pro3 Armband mABC-2 BOTMP	Design ** Sample*** Measure*** Analysis**	Participants aged 6-16 years with cerebral pals increased physical activity during a 4-week intervention using a motion interactive gam (EyeToy) and improved

						1 Minute Walk Test		in motor functions assessed by mABC-2.
Li (2012)	China	Qualitative: explore experiences of physical activity	8	Cerebral palsy	11-16	Interviews	Credibility *** Transferability** Dependability*** Confirmability***	Four themes: (1) Sedentary behaviors – participated in physical activity less than 3 time a week; (2) Enjoyment enjoyed physical activit with family and friends (3) Motivation – being healthy and improving motor function; (4) Barriers – not competer in sports skills and lack of professionals to help improve skills.
Sandlund (2012)	Sweden	Qualitative: explore parents' perceptions using low-cost motion interactive video games for children with CP	19	Cerebral palsy	Parents	Interviews	Credibility ** Transferability* Dependability*** Confirmability***	Three themes: (1) Positive experience for physical training-promotes motivation ar social activity; (2) Independent training; (3 Refinements to interactive video game control performance, individualization, and unobtrusive technology
Lauruschkus (2015)	Sweden	Qualitative: experiences of participating in physical activities	16	Cerebral play/7 participants had mild to moderate limitations of cognitive function	8-11	Individual interview or focus group, parent or personal assistant acted as an advocate	Credibility** Transferability* Dependability** Confirmability***	Two themes: (1) Being physically active, because – enjoy participating, being competent, belonging i group, opportunities are available; (2) Being physically active, but – tired/pain, motor

						during interview or focus group		functions, depending or others, not good enough to participate, not enou opportunities or equipment available to participate
Conchar (2016)	South Africa	Qualitative: barriers and facilitators to participation in physical activity	15	Cerebral palsy	12-18	In-depth, semi-structured interviews	Credibility*** Transferability*** Dependability*** Confirmability*	Four themes: (1) Physiological factors – physical limitations and physical changes during physical activity; (2) Intra-psychological factors – emotions and cognitions during physical activity; (3) social factors – relationships with peers family, and significant others; (4) Macro-environmental – structural factors in regular physical activity programs
Knibbe (2016)	Canada	Qualitative: characterize socially supportive environments relating to participation in physical activity	11	Physical disability that affected body structure and/or function	12-18	In-depth, semi-structured interviews	Credibility*** Transferability** Dependability*** Conformability***	Three themes: (1) Fair and equitable participation – being treated like an equal wi a supportive environment; (2) Belonging through teamwork – feel motivated when belong to a team or group; (3) Socially supported independence – make

								own physical activity goals
Lauruschkus (2017)	Sweden	Qualitative: parents' experiences of physical activity participation for children with CP	25	Cerebral palsy	Parents of children aged 8-11 years	Inductive qualitative approach with individual interviews and focus groups	Credibility** Transferability* Dependability*** Conformability***	Five themes: (1) Belonging and taking space in the family; (2) Important persons facilitating and hinderi (3) Friends important b hard to get; (4) Good fc the body but challengin (5) Availability and opting out possibilities.

References

Bjornson, K., Belza, B., Kartin, D., Logsdon, R., & McLaughlin, J. (2007). Ambulatory physical activity performance in youth with cerebral palsy and youth who are developing typically. *Physical Therapy, 87*, 248-257.

Bloemen, M., Backx, F., Takken, T., Wittink, H., Benner, J., Mollema, J., & De Groot, J. (2014). Factors associated with physical activity in children and adolescents with a physical disability: A systematic review. *Developmental Medicine & Child Neurology, 57*, 137-148.

Bult, M., Verschuren, O., Jongmans, M. Lindeman, E., & Ketelaar, M. (2011). What influences participation in leisure activities of children and youth with physical disabilities? A systematic review. *Research in Developmental Disabilities, 32*, 1521-1529.

Carlon, S., Taylor, N., Dodd, K., & Shields, N. (2013). Differences in habitual physical activity levels of young people with cerebral palsy and their typically developing peers: a systematic review. *Disability & Rehabilitation, 35*, 647-655.

Columna, L., Pyfer, J., & Senne, T. (2011). Physical recreation among immigrant Hispanic families with children with disabilities. *Therapeutic Recreational Journal, 45*, 214-233.

Conchar, L., Bantjes, J., Swartz, L., & Derman, W. (2016). Barriers and facilitators to participation in physical activity: The experiences of a group of South African adolescents with cerebral palsy. *Journal of Health Psychology, 21*, 152-163.

Cook, O., Frost, G., Falk, B., Adkin, A., Klentrou, P., Twose, D., Wallman, L., & Galea, V. (2015) Can-flip: A pilot gymnastics program for children with cerebral palsy. *Adapted Physical Activity Quarterly, 32*, 349-370.

Danhan-Oliel, N., Shikako-Thomas, K., & Majnemer, A. (2012). Quality of life and leisure participation with neurodevelopmental disabilities: A thematic analysis. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care, and Rehabilitation, 21*, 427-439.

Imms, C. (2008). Children with cerebral palsy participate: A review of the literature. *Disability and Rehabilitation, 30,* 1867-1884.

Imms, C., Reilly, S., Carlin, J., & Dodd, K. (2009). Characteristics influencing participation in Australian children with cerebral palsy. *Disability and Rehabilitation, 31*, 2204-2215.

Knibbe, T., Biddiss, E., Gladstone, B., & McPherson, A. (2017). Characterizing socially supportive environments relating to physical activity participation for young people with physical disabilities. *Developmental Neurorehabilitation, 20*, 294-300.

Lauruschkus, K., Nordmark, E., & Hallstrom, I. (2015). "It's fun but…" Children with cerebral palsy and their experiences of participation in physical activities. *Disability and Rehabilitation, 37,* 283-289.

Lauruschkus, K., Nordmark, E., & Hallstrom, I. (2017). Parents' experiences of participation in physical activities for children with cerebral palsy-protecting and pushing towards independence. *Disability and Rehabilitation, 39*, 771-778.

Law, M., King, G., King, S., Kertoy, M., Hurley, P., Rosenbaum, P., Young, N., & Hanna, S. (2006). Patterns of participation in recreational and leisure activities among children with complex physical disabilities. *Developmental Medicine, 48*, 337-342.

Li, C., & Chen, S. (2012). Exploring experiences of physical activity in special students with cerebral palsy: A qualitative perspective. *European Journal of Adapted Physical Activity, 5,* 7-17.

Maher, C., Williams, M., Olds, T., & Lane, A. (2007). Physical and sedentary activity in adolescents with cerebral palsy. *Developmental Medicine & Child Neurology, 49,* 450-457.

Majnemer, A., Shevell, M., Law, M., Birnbaum, R., Chilingaryan, G., Rosenbaum, P., & Poulin, C. (2008). Participation and enjoyment of leisure activities in school-aged children with cerebral palsy. *Developmental Medicine & Child Neurology, 50*, 751-758.

Majnemer, A., Shikako-Thomas, K., Chokron, N., Law, M., Shevell, M., Chilingaryan, G., & Rosenbaum, P. (2009). Leisure activity preferances for 6- to 12-year-old children with cerebral palsy. *Developmental Medicine & Child Neurology, 52*, 167-173.

Majnemer, A., Shikako-Thomas, K., Schmitz, N., Shevell, M., & Lach, L. (2015). Stability of leisure participation from school-age to adolescence in individuals with cerebral palsy. *Research in Developmental Disabilities, 47,* 73-79.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, DG. The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses:* The PRISMA Statement. BMJ 2009;339:b2535,

Murphy, N., Carbone, P., & the Council on Children with Disabilities. (2008). Promoting the participation of children with disabilities in sports, recreation, and physical activities. *Pediatrics, 121*, 1057-1061. doi:10.1542/peds.2008-0566

Palisano, R., Chiarello, L., Orlin, M., Oeffinger, D., Polansky, M., Maggs, J., Bagley, A., & Gorton, G. (2010). Determinants of intensity of participation in leisure and recreational activities by children with cerebral palsy. *Developmental Medicine & Child Neurology, 53*, 142-149.

Powrie, B., Kolehmainen, N., Turpin, M., Ziviani, J., & Copley, J. (2015). The meaning of leisure for children and young people with physical disabilities: A systematic evidence synthesis. *Developmental Medicine & Child Neurology, 57*, 993-1010.

Rimmer, J., & Rowland, J. (2008). Physical activity for youth with disabilities: A critical need in an undeserved population. *Developmental Neurorehabilitation, 11*, 141-148.

Rosenbaum, P., & Gorter, J. (2012). The 'F-words' in childhood disability: I swear this is how we should think! *Child: Care, Health, and Development, 38*, 457-463.

Sandlund, M., Waterworth, E., & Hager, C. (2011). Using motion interactive games to promote physical activity and enhance motor performance in children with cerebral palsy. *Developmental Neurorehabilitation, 14*, 15-21.

Sandlund, M., Dock, K., Hager, C., & Waterworth, E. (2012). Motion interactive video games in home training for children with cerebral palsy: Parents' perceptions. *Disability and Rehabilitation, 34*, 925-933.

Shakiko-Thomas, K., Majnemer, A., Law, M., & Lach, L. (2008). Determinants of participation in leisure activities in children and youth with cerebral palsy: A systematic review. *Physical & Occupational Therapy in Pediatrics, 28*, 155-169.

Shields, N., Loy, Y., Murdoch, A., Taylor, N., & Dodd, K. (2007). Self-concept of children with cerebral palsy compared with that of children without impairment. *Developmental Medicine & Child Neurology, 49*, 350-354.

Telema, R., Yang, X., Viikari, J., Valimaki, I., Wanne, O., & Raitakari, O. (2005). Physical activity from childhood to adulthood: A 21-year tracking study. *American Journal of Preventative Medicine, 28,* 267-273.

Tollerz, L., Forslund, A., Olsson, R., Lidstrom, H., & Holmback, U. (2015). Children with cerebral palsy do not achieve healthy physical activity levels. *Acta Paediatrica, 104*, 1125-1129.

van Eck, M., Dallmeijer, A., Beckerman, H., van den Hoven, P., Voorman, J., & Becher, J. (2008). Physical activity level and related factors in adolescents with cerebral palsy. *Pediatric Exercise Science, 20,* 95-106.

Verschuren, O., Wiart, L., Hermans, D., & Ketelaar, M. (2012). Identification of facilitators and barriers to physical activity in children and adolescents with cerebral palsy. *The Journal of Pediatrics, 161*, 488-494.

Willis, C., Girdler, S., Thompson, M., Rosenberg, M., Reid, S., & Elliott, C. (2017). Elements contributing to meaningful participation for children and youth with disabilities: A scoping review. *Disability and Rehabilitation, 39*, 1771-1784.

World Health Organization. (2013). How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF).

World Health Organization. (2010). Global Recommendations on Physical Activity for Health. (p.16). Geneva: WHO Press.

World Health Organization. (2010). Global Recommendations on Physical Activity for Health. (p.18). Geneva: WHO Press.

Zwier, J., van Schie, P., Becher, J., Smits, D., Gorter, J., & Dallmeijer, A. (2010). Physical activity in young children with cerebral palsy. *Disability and Rehabilitation, 32*, 1501-1508.

III. MANUSCRIPT II: Providing Opportunities for Improving Fundamental Movement Skills and Health-Related Physical Fitness for Students with Developmental Disabilities

Scenario

Ms. Jenkins is an elementary physical education (PE) teacher with a specialty in adapted physical education (APE). She was hired as the PE teacher for the entire school, therefore she is not able to exclusively focus on APE. She has a diverse group of students with different developmental disabilities (cerebral palsy, Down syndrome, Autism Spectrum Disorder, and spina bifida) and ability levels in different grades and classrooms. Three students have cerebral palsy, one student has Down syndrome, and one student has Autism Spectrum Disorder. Some students do not have paraprofessionals due to his/her ability level, but Ms. Jenkins feels she is not able to give each of these students the assistance he/she needs to help in performing the skills or balance activities.

Ms. Jenkins is mindful of how important being included as well as being physically active by performing different fundamental movement and health-related physical fitness skills is for these students. She wants to create an after-school adapted physical activity program for these students once or twice a week for 1 hour. The program will require her guidance and assistance from others. It is important to seek collaboration with the parent-teacher-student association (PTA), a priority consisting of parents, teachers, staff, and potentially high school students seeking community service hours to help with the program.

Ms. Jenkins wants the physical activity program to be fun, focusing on balance, strength, coordination, fundamental movement skills, and basic gymnastics skills. As a pastime recreational gymnastics coach, she is aware of the benefits the basic gymnastics skills can have on students with developmental disabilities. A diverse set of activities will keep the children interested, focused, and continuously active for the hour long program. She wants the activities to be applicable for each student's ability level yet challenging to help him/her improve their fundamental movement skills and health-related physical fitness.

Introduction

The health and psychosocial benefits of participating in physical activity are important for all children including those with developmental disabilities (e.g., Autism Spectrum Disorder, Down syndrome, cerebral palsy and spina bifida) for overall well-being (Murphy & Carbone, 2008). The benefits of physical activity include improved health-related physical fitness, functioning for activities of daily living, skill development, and competence and socialization through inclusion (Collins & Staples, 2017). Children with developmental disabilities participate less in physical activities and have lower physical fitness levels than their typically developing peers (Murphy & Carbone 2008). The decrease in physical activity participation is due to low physical fitness, motor competence, motor impairments, and opportunities in the community (Collins & Staples, 2017). Movement and motor competence are important for physical activity participation (Stodden et al., 2008). Therefore, it is imperative to provide recreational and sport programs that allow each child to progress at his/her own level in the least restrictive environment to promote improvements in motor competence and improving physical fitness (Murphy & Carbone, 2008).

Providing an afterschool physical activity program that is adaptable to meet the needs of children with different types of developmental disabilities would be ideal. The basic skills in a gymnastics program are easily modifiable to meet different motor abilities of children with developmental disabilities (Cook et al., 2015; Moraru et al., 2014) along with a few basic guidelines. The difference between an adapted and non-adapted program is the amount of assistance for each child, adapting the skills to the ability of the child, and continuing to challenge his/her motor skills for progression (Cook et al., 2015).

This article will provide a sample lesson plan for an adaptive physical activity program that focuses on basic gymnastics skills, fundamental movement skills, and health-related physical fitness consisting of 6 stations with 1-3 activities at each station. The lesson plan includes ways to adapt the activity for children with different developmental disabilities. It can be implemented in a gymnastics facility, gymnasium, or other settings. We collaborated with an international charitable non-profit organization, iCan Shine, that provides recreational activities for individuals with disabilities by creating learning opportunities in an environment that allows each individual to shine and maximize his/her individual abilities (iCan Shine, Inc.).

Table 3.1 Activity Equipment List

Equipment List
Gymnastics panel mats – 7; Painter's tape – 1; Bean bags – 15; Balance dome or bosu ball -2; Sensory ball – 1; Small bucket – 1; Panel mats – 6; Tunnel – 1; Pool noodle – 1; Jump rope – 1; Sensory stepping stones – 3 or 4; River stones – 3 or 4; Cones – 5; Dice – 1; Poly spot -1; Jump rope – 1; Hula hoops – 3; Hula hoop holders – 3; Rope – 1; Gymnastics single bar – 1; Spotting block -1; Cheese wedge – 1 or 2; Mat – 1; Octagon mat – 1; Foam paddles – 1 or 2; Tennis balls – 1 or 2. *Mat is used for handstand up against the wall. You can use mat or cheese wedge for handstand. Make sure it is steady against wall before child performs handstand*

Safety

Space availability and providing assistance are key to performing the different activities in an adaptive physical activity program for students with developmental disabilities particularly those with physical disabilities. When setting up the 6 stations make sure there is enough room for students who use assistive devices (i.e., canes, walker, or wheelchair). Stations may have to be combined or removed depending on space availability. For an adaptive physical activity, it is best to have assistance provided at each station when possible. Demonstrating the skill and assisting the student when performing the skill for the first time is beneficial. If you observe the student not needing as much or no assistance at all, allow the student to perform the skill again without assistance or slowly fade away the assistance as the student progresses. Although it is important to promote independence in performing the different activities, remember safety comes first.

Warm-up

When beginning any type of exercise, sport or recreational program, it is important to warm-up for 10-15 minutes. Guide students through the different warm-up exercises and stretches. The warm-up exercises focus on locomotor skills to increase blood flow throughout the entire body as well as improve skills. When the warm-up exercises are performed by students with developmental disabilities the focus is on performing the locomotor skills independently not how the skills look. After the warm-up, have the students form a circle, stand side-by-side or stagger to do the stretches. Students may require assistance to get in the position of a particular stretch. Demonstrate all warm-up exercises and stretches. An example of a warm-up and two additional fun warm-up activities are listed in Table 2.

Table 3.2 Warm-up Activities

Example Warm-up

- Create a warm-up area using 2 cones placing one on each end for students to travel between when performing the locomotor drills
- Provide students with bean bags to drop off at one end and pick up at the other
- Locomotor drills - run, skip, jump, hop, march, gallop, bear walk, crab walk, walk on tip toes, and walk on heels
- Form a circle or staggered line to stretch- stand up tall and bend down to touch toes, sit in a pike, straddle, butterfly, tuck, and tuck balance

Warm-up #1

- Everyone shakes the parachute
- Shake in tuck position, shake standing up, tuck, stand, tuck, stand….
- Shake while students chasse (open close) then the other direction
- Can continue holding parachute and performing different locomotor movements such as skipping, jumping, and walking on tip toes
- Students sit and shake parachute. Depending on number of students and instructors, determine what students will go on top of the parachute (clothing color, age, birthday, boys, girls, etc.). They perform different locomotor moves on top of the parachute while others shake. They can try to pop the bubbles. Locate different colors, perform different actions on the different colors
- Place light weight balls or bean bags and students 'pop the popcorn'

Warm-up #2

- Set out hula hoops
- When the music starts students perform the instructed locomotor skill or movement. When the music stops everyone has to find a hoop
- You can remove hoops so students have to share at some point or leave all hoops out.
- Locomotor drills - run, skip, jump, hop, march, gallop, bear walk, crab walk, walk on tip toes, and walk on heels

Stations

Between 45-50 minutes of the program will be performing the different activities at the 6 stations. Allow the students to rotate from one station to the other independently. The 6 stations in this lesson plan focus on balance, coordination, strength, motor skills, and promoting socialization skills. Providing several different activities for the students to choose from may help improve cognitive flexibility to understand the different demands of each activity while rotating between the 6 stations.

Table 3.3 Station 1 – Activities 1 and 2	
Activity # 1 – Hopping/Jumping Tic-Tac-Toe	
Equipment: Painter's tape 10 bean bags	Directions: -Hop to the square -Place bean bag -Activity is completed when someone wins tic-tac-toe or all 9 squares are filled. The activity can be completed with one or two individuals (student and assistant or two students) to help encourage social skills.
Aim: Hopping with one foot or jumping with two feet depending on the ability of the student.	Adapting: -First have the student jump with two feet. As it becomes easier have the student switch to hopping with one foot. -If student already hops on one foot well, challenge the student to hop on non-favorite foot or hopping with two feet to the left, right, forwards and backwards to the next square while keeping feet together. -For a student with spina bifida or cerebral palsy that uses a wheelchair, but is able to be mobile not using wheelchair such as scooting, allow him/her to not use wheelchair and scoot using arms for support. Moving his/her body to the different squares using his/her arms will help build upper body strength.
Activity # 2 – Balance and Catching (10 catches and throws)	
Equipment: 2 bosu balls or balance domes 1 sensory ball	Directions: -Two bosu balls setup a few feet apart -Two students throw and catch sensory ball while standing on bosu ball
Aim: Balance and catching; improving hand-eye coordination 	Adapting: -Depending on student's balance ability, he/she may need to be stabilized while standing on bosu ball. Students can practice balancing on bosu ball before attempting to throw or catch. -As the student progresses in balancing the amount of assistance may be lessened and increasing the distance between the bosu balls as catching and throwing progresses. -A student with spina bifida may not be able to fully stand on both feet depending on the type. Standing on knees on the bosu balls with assistance at the waist would be beneficial for this activity. 

Table 3.4 Station 1 – Activity 3	
Activity # 3 – Plank hold and Push-ups	
Equipment: 1 panel mat 1 bucket 5 bean bags	Directions: -Student performs 5 – 10 pushups or completes plank hold activity. -Students can complete both. The exercise will depend upon the ability level of the student in performing the plank, push-ups, or both. -In a plank position the student will place the 5 bean bags in the bucket one at a time with left hand then right hand.
Aim: Upper arm strength and abdominal strength 	Adapting: -Student should be able to hold the plank position for 10-15 seconds before placing bean bags in a bucket. -For students with cerebral palsy this task may be difficult with one side being much stronger than the other. May be beneficial to have student begin plank using forearms for support then progress to push-up position -Push-ups should be completed when the child is able to properly hold the plank position. 

Table 3.5 Station 2 and Station 3	
Station 2 - Activity # 1 – Obstacle Course	
Equipment: Panel mat - 1 Tunnel - 1 Pool noodle - 1 Sensory stepping stones – 3 or 4 River stones – 3 or 4 Cones - 5 Dice - 1 Poly spot - 1 Jump rope - 1 Hula hoops – 3 Hula hoop holders - 3 	Directions: -Obstacle course can be setup in a circular fashion or straight line depending on the available space. -Place tunnel on top of 1 panel mats for the students to crawl under the tunnel using the army crawl for moving themselves forward. -Pool noodle, sensory stepping stones, and dome cones -5 cones – set up in a circle and place dice in the middle *Students throw dice to see what number it lands on. Have a choice of doing a plank, push-ups, squats or jumping jacks* -Jump rope – place jump rope on poly spot. Students perform 5-10 jumps -Hula hoops – set hula hoops up in stands for students to go through
Aim: Balance, coordination and jumping	Adapting: -For students who use wheelchairs such as students with cerebral palsy and spina bifida, allow him/her to complete obstacle course by scooting for mobility. -Students with cerebral palsy and spina bifida can be assisted and held upright to walk across pool noodle, cones, and stepping stones. -Jump rope with 10-15 high marches using walker, canes, or sitting in wheelchair for support.
Station 3 – Activity # 1 – Scooters	
Equipment: Scooters – 2 Rope -1	Directions: -Student moves forward by lying on stomach and using arms or sits on bottom and uses feet. -Student can pull rope to help him/her move across the floor. Using the rope helps with hand strength and grasping (fine motor skill).
Aim: Balance and upper arm strength 	Adapting: -If student is able to balance sitting upright on his/her own allow them to complete activity on their own either on bottom, stomach or pulling rope. -For students who need support sitting up straight on scooter allow them to lie on stomach and use hands to move forward or use rope to pull themselves forward.

Table 3.6 Station 4 – Activity 1	
Activity # 1 - Hanging, Pull-ups and Front support	
Equipment: Gymnastics single bar – 1 Panel mat – 1	Directions: -Hanging from the bar with both hands works on grip strength. For hanging count how many seconds student is able to hold on before letting go. -Pull-ups-perform 3-5 pull-ups with support and assistance. Students can always perform more and to his/her ability. -Front support-focuses on upper body strength. Students need to have straight arms to be able to support themselves and gain benefits from the skill.
Aim: grip strength and upper body strength	Adapting: -Hanging- this skill may be difficult for students with cerebral palsy as one side of the body is stronger than the other, therefore assistance will be needed and lessened as child progresses. Assistance can be performed while holding student's waist. -Pull-ups-this skill may be difficult and most students will need assistant pulling their chin to the bar. Placing a block under the bar supports the students in performing the pull-up helping them focus only using their upper body. If student is already successful in pull-ups, have the student practice holding chin his/her chin to the bar for 5-10 seconds. -Front support-assistance and support will be needed for all students in performing this skill. Placing a block underneath the bar for the child to stand on is beneficial and can be removed as the child progresses.

Table 3.7 Station 4 – Activity 2	
Activity # 2 – Forward rolls, Log rolls and Spiderman hold	
Equipment: Panel mats – 4 Cheese wedge – 1 Octagon mat - 1	Directions: -Cheese wedge is for performing log rolls and forward rolls -Octagon mat is used for performing the Spiderman hold
Aim: Rotation, balance, arm and abdominal strength  	Adapting: -Starting with the log rolls might be best and then progressing to forward rolls. -Log rolls are performed rolling down cheese wedge while body is stretched out horizontally across cheese wedge with legs and arms straight and arms above head. -Forward rolls are performed beginning in the squat position and hands placed out on front on the cheese wedge. Students will tuck chin to chest looking hard at belly button. Make sure chin is tucked to chest and pressure is off neck before rolling down cheese wedge. Once students have mastered the forward roll on the cheese wedge on their own. Forward roll may be performed on panel mat with assistance. *Not all students will be able to perform the forward roll due to ability* -Log roll can be performed on cheese wedge and panel mat. -Spiderman hold on octagon mat requires assistance until students have mastered balancing in this position. Students will lie stomach on top of octagon mat walking hands out in front. Hands should be far enough out front to have shins or feet only on mat. Students should be holding a plank like position. To get out of position students can bring feet down off mat with assistance one at a time or walk hands back towards mat and end the way they started the skill.

Table 3.8 Station 5 and Station 6	
Station 5 - Activity # 1 – Striking	
	Directions: The one-hand strike with the foam paddle is much like the forehand strike in tennis -Bounce ball with non-dominant hand -Hit ball with dominant hand towards the wall
Aim: One-hand strike	Adapting: -This skill will need to be demonstrated. It is a timing skill of knowing when to hit the ball with the paddle. Students may become frustrated so encouragement and patience is key from the assistants.
Station 6 – Activity #1 - Handstand	
Equipment: Panel mat -1 Cheese wedge or mat to prop up against wall - 1	Directions: Student places both hands on panel mat then walks feet up the mat.
Aim: Balance, arm and abdominal strength 	Adapting: This skill may be difficult for students with cerebral palsy and spina bifida, but will depend on type as well as ability level. Students do not have to walk feet all the way up the mat. Provide assistance as needed.

Suggestions for Implementation

The sample lesson plan focuses on a variety of fundamental movement skills and health-related physical fitness skills across 6 stations that include adaptations for students with physical disabilities, such as cerebral palsy and spina bifida. Activities at the 6 stations may provide challenges for the students. Being challenged may cause frustrations so it is important for the assistant to the student to provide emotional and motivational support as well as knowing when the student may need a break. Physical support and safety is important for students at stations,

particularly the catching and throwing on the bosu balls, obstacle course, and the basic gymnastics skills.

Physical support is important, but it is also important to promote physical independence for the students in this environment. Allow students to rotate on their own to the different stations with the option of using or not using the assistive device for mobility. Most stations, if not all in the lesson plan do not require the use of wheelchairs, but can be used for rotating to the different stations. It is encouraged for the student to use his/her body to the best of his/her ability to help improve strength, range of motion, balance and coordination for mobility creating more physical independence.

Focusing on the student's individual progressions will help improve student's motor competence. Demonstrate the activity for the student to observe before beginning the activity. Allow student to try on his/her own, but an assistant should be ready to assist at all times. Depending on the student's successes at the different activities and time permitting to complete stations more than once, the activities can be adapted to provide individual progression. Progressions for the activities at the stations are provided in the sample lesson plan.

Conclusion

An afterschool adaptive physical activity program for children with developmental disabilities requires space availability and an adequate amount of assistance depending on the number of students for different skills. The basic gymnastics skills, motor skills, and fitness activities are modifiable for different ability levels and can be easily included in a physical education program for all children. Adaptations for the different skills include providing more or less assistance for each skill, removing or providing additional equipment at the different

stations, and challenging fitness skills with additional repetitions and time. Providing assistance to each student focuses on individual ability level, progression level of different skills and improving motor competence. The different stations in the lesson plan provide continuous movement as the students rotate to each one completing the different skills and rotating through more than once as time permits. The program can be implemented in a PE classroom, gymnasium or even a gymnastics facility. If there is no space availability for a lesson plan such as this one, there is always the option of being outside if the weather permits. Being outside has the advantage of not needing the gymnastics panel mats for the different skills. If some of the equipment provided in the lesson plan is not feasible, other equipment may be substituted that may be more resourceful (see Table 9). Researchers have stated the importance of leaving the clinical setting and providing physical activities for children with developmental disabilities in the community (Collins & Staples, 2017). A program such as this would provide opportunities for children with developmental disabilities and their families to participate in physical activity within the community to improve motor competence and other skills can be used at home, school, and other recreational activities.

Table 3.9 Other Resources

A gymnastics bar used for working on grip strength and upper body strength can be substituted for Lebert Equalizer Total Body Strengthener for $99.95 at **www.eNasco.com/physicaleducation**.

Exercises:

-Tuck and pike holds

-Push-ups

-Chin-ups (chin to the bar)

-These exercises work on grip strength and health-related physical fitness skills – strength, balance, and coordination.

References

Collins, K., & staples, K. (2017). The role of physical activity in improving physical fitness in children with intellectual and developmental disabilities. *Research in Developmental Disabilities, 69*, 49-60.

Cook, O., Frost, G., Twose, D., Wallman, L., Falk, B., Galea, V., Adkin, A., & Klentrou, P. (2015). Can-flip: A pilot gymnastics program for children with cerebral palsy. *Adapted Physical Activity quarterly, 32*, 349-370.

iCan Shine, Inc. (2018). Retrieved from https://icanshine.org/

Moraru, C., Mihaela, H., & Dumitru, V. (2014). The role of gymnastics and dance in rehabilitating motor capacities in children with down syndrome. *Journal of Physical education, Sports and Related Sciences, 14*, 102-112.

Murphy, N., Carbone, P., & the Council on Children with Disabilities (2008). Promoting the participation of children with disabilities in sports, recreation, and physical activities. *Pediatrics, 121*, 1057-1061.

Stodden, D., Goodway, J., Langendorfer, S., Roberton, M., Rudisill, M., Garcia, C., & Garcia, L. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest, 60*, 290-306.

Wilson, W., Beamer, J., & Block, M. (2016). Adapted Physical Education in self-contained settings: Planning for successful instruction. *Strategies, 29*, 22-30.

IV. MANUSCRIPT III: Improving Fitness, Executive Function and Competence of Children with Developmental Disabilities through an Adapted Gymnastics Intervention

Introduction

Children with developmental disabilities (e.g., cerebral palsy, Down syndrome, Autism Spectrum Disorder, etc.) participate in less physical activity than their typically developing peers (Murphy & Carbone, 2008; Bandini, Gleason, Curtin, Lividini, Anderson, Cermak, Maslin & Must, 2013; Collins & Staples, 2017), have lower fitness levels (Murphy & Carbone, 2008; Collins & Staples, 2017), have lower motor competence (Collins & Staples, 2017) and experience difficulty performing fundamental movement skills (Staples & Reid, 2010; Capio, Sit, Abernethy, & Masters, 2012; Collins & Staples, 2017). Physical activity participation helps improve health-related fitness, psychological well-being, socialization, bone strength, independence performing daily activities, and competence (Murphy & Carbone, 2008). Without regular physical activity participation children with developmental disabilities are at risk for lower fitness levels, increased dependence performing daily activities, low self-esteem and decreased social acceptance (Murphy & Carbone, 2008). If children perceive physical activity to be fun and enjoyable, they are more likely to continue to participate as an adolescent and an adult (Cook, Frost, Twose, Wallman, Falk, Galea, Adkin, & Klentrou, 2015). Therefore, it is imperative to provide adaptive physical activity opportunities for children with developmental disabilities outside of the clinical setting and in the community (Cook et al., 2015). The American Academy of Pediatrics and the Council on Children with Disabilities stated the

importance for increasing physical activity in children with disabilities and providing programs within the community to promote health, physical fitness and a lifetime of physical activity participation (Murphy & Carbone, 2008).

Recent research studies have employed community-based physical activity interventions for children with developmental disabilities to improve health-related physical fitness skills and competence (Collins & Staples, 2017; Cook et al., 2015; Haney et al., 2014; Davis, Zhang & Hodson, 2011; Fragala-Pinkham, Haley & Goodgold, 2006). For example, Cook et al. (2015) developed a 6-week gymnastics program (1 hour 2 x a week) at a local gymnastics facility for 5 participants with cerebral palsy. The program provided opportunities for children to participate in a typical gymnastics class after the intervention. Each participant improved in the gymnastics skills as well as range of motion and functional motor performance. Collins and Staples (2017) developed a 10-week community-based program for children with Down syndrome and Autism Spectrum Disorder (1.5 hours 1 x a week) that focused on fundamental movement skills and resulted in improved in health-related physical fitness. The authors of these two studies stated that providing physical activity programs within the community that are fun, feasible and accessible can improve physical fitness, competence, and socialization for children with developmental disabilities is vital to promote lifelong participation in physical activity (Cook et al., 2015; Collins & Staples, 2017).

Beyond these improvements in motor ability and health-related fitness, improvements in cognitive function, particularly executive function (EF) (i.e., inhibition, attention, cognitive flexibility, and working memory) may result from participation in community-based adapted physical activity programs. For example, improvements in EF were observed after participation in physical activity interventions in typically developing children (Diamond & Ling, 2016).

Moreover, improvements in EF were observed when children participate in physical activities and sports that are cognitively challenging (Lakes & Hoyt, 2004). In order to see improvements, EF needs to be continually challenged (Diamond & Ling, 2016) and go beyond one's own competence level or comfort zone (Ericsson, Nandagopal, & Roring, 2009). However, no studies have examined improvements in EF in children with disabilities participating in an adapted motor skill/sport intervention. Taken together, programs aimed at increasing physical fitness may confer important non-motor benefits for those with developmental disabilities, particularly when they are cognitively challenging.

The purpose of this study is to quantify changes in health-related physical fitness, specific domains of perceived competence and executive function in children with developmental disabilities following a 10-week (20 sessions) adapted gymnastics intervention and after a 13-week (13 session) follow-up. Consistent with previous studies, it was hypothesized that participants would improve health-related physical fitness and perceived competence as a result of their involvement in the intervention. Additionally, it was hypothesized that children would show greater executive function (i.e., inhibition, attention, and cognitive flexibility) following the intervention.

Methods

Participants

Table 4.1 presents the details for the participants (age and disability). A total of 5 children (3 males, 2 females) ranging in age from 7-11 years ($M = 9$, $SD = 1.58$) with developmental disabilities (cerebral palsy, Down syndrome, and Sensory Processing Disorder) participated in the study. The participants were recruited from a local pediatric physical therapy

clinic and through participation in past research and outreach programs in the Pediatric Movement and Physical Activity Lab.

The study protocol was approved by the Institutional Review Board at Auburn University. Participants provided written or verbal assent and parents provided written informed consent.

Table 4.1 Participant Characteristics

Participant	Sex	Age	Disability
GYM001	F	10	Cerebral palsy – GMFC II (left hemiplegia)
GYM002	M	7	Cerebral palsy and Autism – GMFC III (triplegia). Used walker for support while rotating through stations.
GYM003	M	11	Cerebral palsy – GMFC I (right hemiplegia)
GYM004	F	7	Sensory Processing Disorder and ADHD
GYM005	M	9	Down syndrome

Measures

Data were collected at three time points: before the intervention (pre-test), after the 10-week program (post-test 1), and after the 13-week follow-up (post-test 2). Participants completed the Brockport Physical Fitness Test, Harter's Scale of Perceived Competence, and the Flanker and Dimensional Change Card Sort tasks from the NIH toolbox Cognitive Battery at all three time points.

Fitness Skills

Brockport Physical Fitness Test (Winnick & Short, 2014) is an adapted fitness test commonly used by physical educators and included the following measurements: isometric push-

up, modified curl-up, trunk lift, grip strength, extended arm hang, and back saver sit-and-reach. The raw values for reach task were used in the current analysis.

Perceived Competence

Harter's Pictorial Scale of Perceived Competence and Acceptance for Young Children (Harter & Pike, 1984), particularly used for typically developing children, was administered verbally to participants aged 7-8 years as well as participants with an intellectual disability. Self-Perception Profile for Children (Harter, 2012) was administered to participants aged 9-11 years. Harter's Pictorial Scale consists of four domains (cognitive, physical, peer and maternal) with 6-item scales. The cognitive, physical, and peer domains were used for the current data analysis. The Self-Perception Profile for Children consists of six domains (scholastic, social, athletic, physical, behavioral and self-worth) with 6-item scales. The scholastic, athletic, and social domains were used for the data analysis. For the current study, it was hypothesized that perceived competence would improve in particular domains as the result of participating in the intervention, such as increased social relatedness, increased fitness to perform skills, and cognitive/scholastic skills, therefore the perceived competence domains (cognitive/scholastic, peer/social, and physical/athletic) from the two different scales were chosen for the data analysis. Cognitive, physical, and social will be referred to as the perceived competence domains for the current study.

Executive Function

Two tasks from the NIH Toolbox Cognitive Battery (Weintraub et al., 2013) were used to examine executive function. The Flanker Task assessed inhibition and attention. The

Dimensional Change Card Sort Task assessed cognitive flexibility. These tasks are valid for typically developing individuals' ages 3-87 years. Both tasks were administered on an iPad.

Intervention

Fall semester: The 10-week adapted gymnastics intervention consisted of 2 one-hour sessions per week (total of 20 sessions). One session during each week took place at a local gymnastics facility with the participants performing basic gymnastics skills on the uneven bars, floor, balance beam, vault, and trampoline. The lesson plan was created by iCan Shine, a national non-profit organization that provides adapted recreational activities for individuals with disabilities (e.g., adapted bicycle training, swimming lessons, dance, and gymnastics programs). Certified gymnastics instructors led the one-hour session. The second session during each week of the intervention took place in the Pediatric Movement and Physical Activity Lab at Auburn University and focused on fitness incorporated in fundamental movement activities at different stations using mats, balance boards, large foam wedges, a bar, low balance beams, scooters and other small equipment common in physical education classes.

Spring semester: the participants completed an additional 13 sessions (1 hour/1x a week) adapted gymnastics program that took place in the Pediatric Movement and Physical Activity Lab at Auburn University. Similar to the Fall Semester, the program in the Pediatric Movement and Physical Activity lab focused on fitness incorporated in fundamental movement activities at different stations.

Assistants: the participants were assisted by undergraduate research assistants for both Fall and Spring semesters. For the Fall semester certified gymnastics instructors (USAG), which included the Principle Investigator (PI) of the current study, assisted participants at the local

gymnastics facility on the apparatuses. Participants were assisted throughout the sessions with a 1:1 or 2:1 ratio depending on participant's ability level. Undergraduate research assistants were trained for the adapted gymnastics intervention and to administer the assessments (pre-test, post-test1, and post-test2). Participants' developmental disabilities and ability level were discussed in detail to the assistants by the PI during training. Assistants were instructed on giving emotional support, positive verbal reinforcement, and modifications at different stations to help the participants. Before each session, assistants were given detail instructions of lesson plan and how to adapt to the skill/task to the participants. PI was present at sessions to provide additional assistance.

Data Analysis

To determine the overall changes across time (T1 = pre-test; T2 = post-test 1; T3 = post-test 2), repeated measures ANCOVA (i.e., pre-test predicted post-tests) was examined for each variable with respect to Pre-test (covariate), Time (within subjects factor), and the Pre-test x Time interaction. Due to our small sample size ($N = 5$) ANCOVA was used to increase statistical power by controlling for individual variability in pre-test scores and thereby reduce sampling variance.

Paired *T*-tests were used to determine differences in scores from pre-test (T1) to post-test 1 (T2), and pre-test (T1) to post-test 2 (T3) and post-test 1 (T2) to post-test 2 (T3). We computed Cohen's d to estimate effect sizes for each comparison. The following dependent measures were assessed: isometric push-up, modified curl-up, trunk lift, grip strength, extended arm hang, sit-and-reach, physical/athletic competence, social competence, cognitive/scholastic competence,

flanker, and dimensional change card sort. All data were analyzed using RStudio (1.0.136) and the level of significance was set at $p < 0.05$.

Results

Fitness

Figure 4.1 represents the Brockport Fitness Test tasks for each of the three time points for each participant. Table 4.2 presents the coefficients (*ß)*, *F*-values, and *P*-values for the Brockport Fitness Test tasks from the repeated measures ANCOVA. Significant pre-test effects were observed for the isometric push-up and grip strength ($p < 0.05$ for both). An effect of time effect approached conventional significance for the trunk lift *(*$p = 0.063$), but none of the other measures revealed a significant time effect ($p > 0.05$ for all). No Pre-test x time interaction was observed for any of the Brockport Fitness Test measures ($p > 0.05$ for all).

Figure 4.1 Results for Brockport Fitness Tasks at T1, T2, and T3

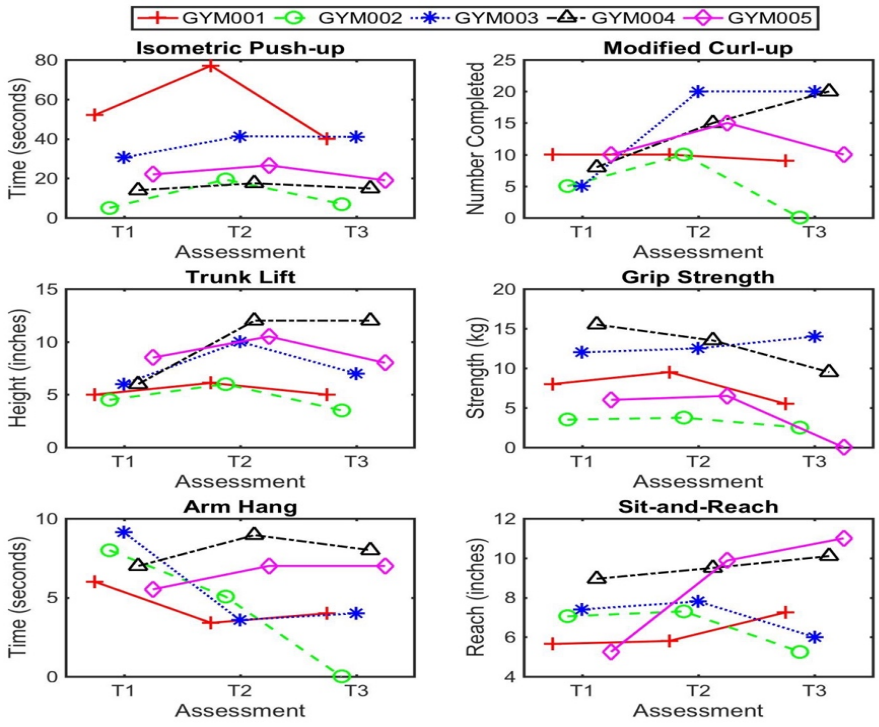

Table 4.2 RM ANCOVA – Fitness

	Measure	ß	*F*-Value	*P*-Value
Isometric push-up	Pre-test	1.04	63.73	0.0041
	Time	-11.97	4.58	0.122
	Pre-test x Time	-0.558	2.57	0.207
Modified curl-up	Pre-test	-0.206	0.022	0.891
	Time	-2.20	0.608	0.492
	Pre-test x Time	0.540	0.184	0.697
Trunk lift	Pre-test	1.1	1.51	0.307
	Time	-1.82	8.36	0.063
	Pre-test x Time	-0.147	0.104	0.768
Grip strength	Pre-test	0.875	13.17	0.036
	Time	-2.85	3.33	0.166
	Pre-test x Time	0.097	0.071	0.808
Extended arm hang	Pre-test	-0.784	10.61	0.438
	Time	-0.998	0.743	0.452
	Pre-test x Time	-0.476	0.293	0.626
Sit-and-reach	Pre-test	0.080	0.011	0.924
	Time	-0.135	0.029	0.876
	Pre-test x Time	-0.420	0.485	0.536

Table 4.3 represents the means and standard deviations for each time point as well as the statistics for the paired comparisons across time for the Brockport Fitness Test measures. Paired *T*-tests were examined to determine any subtle changes between time points that may have been obscured in the repeated measures ANCOVA. Significant improvements were observed from pre-test to post-test 1 for the isometric push-up, curl-up, and trunk lift ($p < 0.05$ for all). A significant decrease was observed from post-test 1 and post-test 2 for the trunk lift ($p < 0.05$). None of the other comparisons revealed significant differences across time ($p > 0.05$ for all).

Table 4.3 T-Test - Fitness

Measure	Pre-test Mean (SD)	Post-test 1 Mean (SD)	Post-test 2 Mean (SD)	Pre-test to Post-test 1	Pre-test to Post-test 2	Post-test 1 to Post-test 2
Isometric push-up	24.71(17.95)	36.34(24.58)	24.37(15.35)	$T(4) = -2.98$, $p = 0.041$	$T(4) = 0.092$, $p = 0.931$	$T(4) = 1.81$, $p = 0.144$
Modified curl-up	7.6(2.51)	14(4.18)	11.8(8.44)	$T(4) = -2.62$, $p = 0.059$	$T(4) = -1.07$, $p = 0.344$	$T(4) = 0.874$, $p = 0.432$
Trunk lift	6(1.54)	8.92(2.72)	7.1(3.25)	$T(4) = -3.18$, $p = 0.033$	$T(4) = -0.867$, $p = 0.435$	$T(4) = 3.28$, $p = 0.030$
Grip strength	9(4.78)	9.15(4.08)	6.3(5.57)	$T(4) = -0.259$, $p = 0.808$	$T(4) = 1.77$, $p = 0.152$	$T(4) = 2.08$, $p = 0.106$
Extended arm hang	7.13(1.47)	5.60(2.37)	4.6(3.13)	$T(4) = 1.08$, $p = 0.342$	$T(4) = 1.40$, $p = 0.235$	$T(4) = 0.950$, $p = 0.396$
Sit-and-Reach	6.86(1.48)	8.06(1.67)	7.92(2.53)	$T(4) = -1.39$, $p = 0.237$	$T(4) = -0.784$, $p = 0.477$	$T(4) = 0.181$, $p = 0.865$

Perceived Competence

Figure 4.2 represents the Perceived Competence domains (cognitive, physical, and social) for each of the three time points for each participant. Table 4.4 presents the coefficients (*ß)*, *F*-values, and *P*-values for the Perceived Competence domains from the repeated measures ANCOVA. A significant pre-test effect was observed for cognitive competence and physical competence ($p < 0.05$ for both). No significant time effect or Pre-test x Time interaction was observed for any of Perceived Competence domains ($p > 0.05$ for all).

Figure 4.2 Results for Perceived Competence Domains at T1, T2, and T3

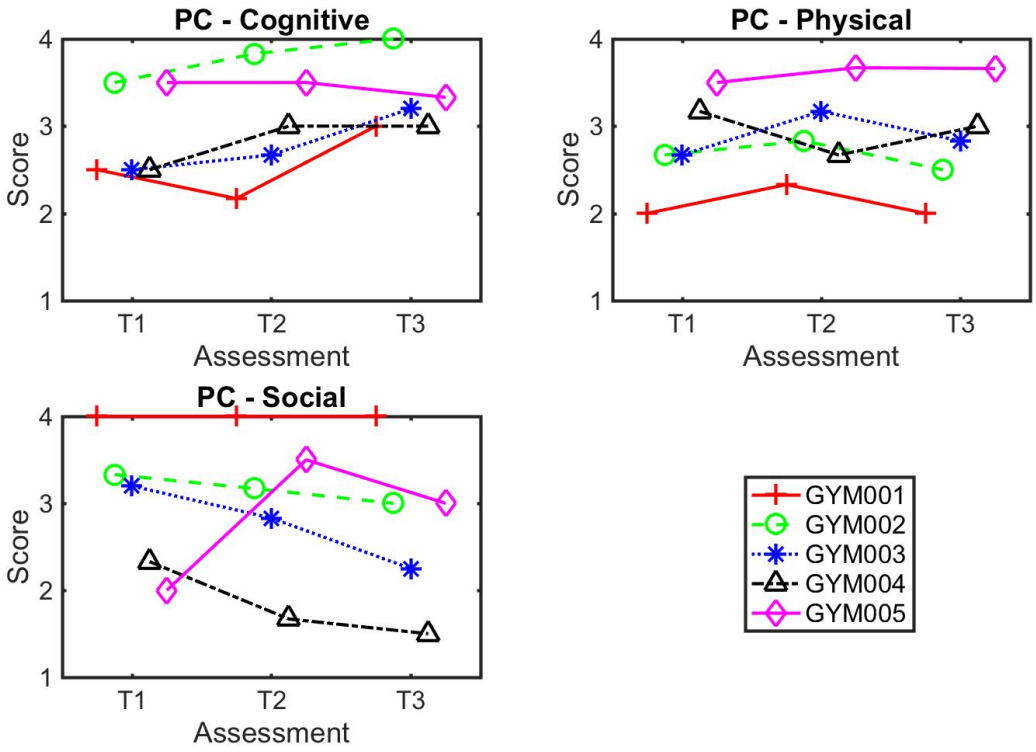

Table 4.4 RM ANCOVA – Perceived Competence

	Measure	ß	*F*-Value	*P*-Value
Cognitive competence	Pre-test	0.825	10.91	0.046
	Time	0.272	2.7	0.199
	Pre-test x Time	-0.453	1.8	0.272
Physical competence	Pre-test	0.859	12.56	0.038
	Time	-0.136	1.53	0.305
	Pre-test x Time	0.359	2.77	0.194
Social competence	Pre-test	0.624	1.37	0.327
	Time	-0.284	6.77	0.080
	Pre-test x Time	0.155	1.05	0.382

Table 4.5 represents the means and standard deviations for each time point as well as the statistics for the paired comparisons across time for the Perceived Competence domains. Paired *T*-tests were examined to determine any subtle changes between time points that may have been

obscured in the repeated measures ANCOVA. Although none of the comparisons revealed significant differences across time ($p > 0.05$ for all), the difference between pre-test to post-test 2 for cognitive competence approached conventional statistical significance ($p = 0.053$).

Table 4.5 T-Test – Perceived Competence

	Mean1 (SD)	Mean 2 (SD)	Mean 3 (SD)	Pre-test to Post-test1	Pre-test to Post-test2	Post-test1 to Post-test2
Cognitive competence	2.9(0.548)	3.03(0.658)	3.31(0.413)	$T(4) = -0.939$, $p = 0.401$	$T(4) = -2.72$, $p = 0.053$	$T(4) = -1.50$, $p = 0.208$
Physical competence	2.80(0.570)	2.93(0.511)	2.80(0.615)	$T(4) = -0.777$, $p = 0.480$	$T(4) = 0.054$, $p = 0.959$	$T(4) = 1.03$, $p = 0.362$
Social competence	2.97(0.805)	3.03(0.876)	2.75(0.935)	$T(4) = -0.165$, $p = 0.877$	$T(4) = 0.634$, $p = 0.561$	$T(4) = 2.59$, $p = 0.061$

Executive Function

Figure 4.3 represents the Flanker and Dimensional Change Card Sort for each of the three time points for each participant. Table 4.6 presents the coefficients (*ß)*, *F*-values, and *P*-values for the Flanker and Dimensional Change Card Sort from the repeated measures ANCOVA. No significant pre-test effect was observed for either measure ($p > 0.05$ for both). A significant time effect was observed for Flanker ($p < 0.05$), but not for the Dimensional Change Card Sort ($p > 0.05$). No Pre-Test x Time interaction was observed for either variable ($p > 0.05$ for both).

Figure 4.3 Results for Flanker and Dimensional Change Card Sort at T1, T2, and T3

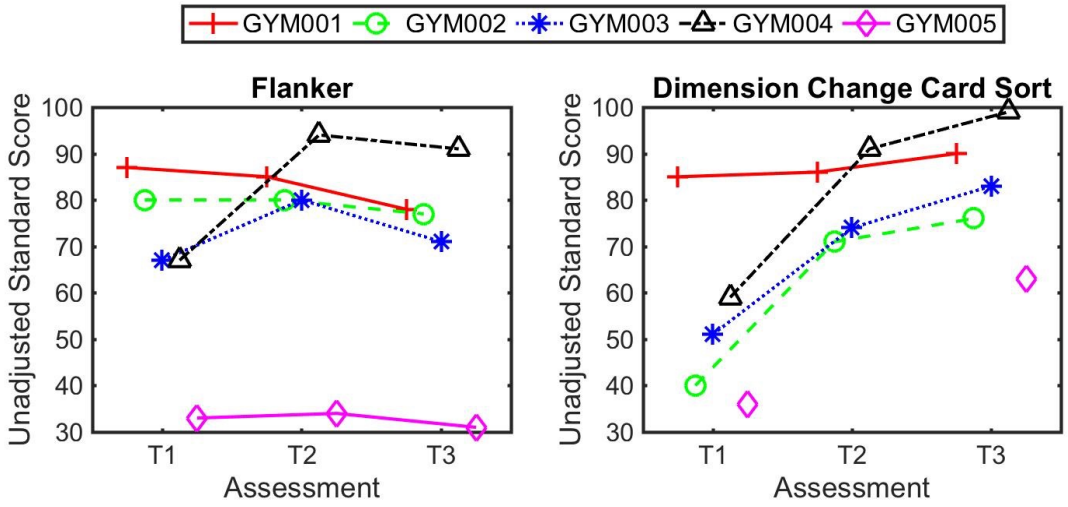

Table 4.6 RM ANCOVA – Executive Function

	Measure	ß	*F*-Value	*P*-Value
Flanker	Pre-test	0.937	7.48	0.072
	Time	-5.00	13.34	0.035
	Pre-test x Time	-0.048	0.416	0.565
Dimensional Change Card Sort (DCCS)	Pre-test	0.857	2.48	0.214
	Time	17.80	2.65	0.202
	Pre-test x Time	-0.716	1.29	0.337

Table 4.7 represents the means and standard deviations for each time point as well as the statistics for the paired comparisons across time for the Flanker and Dimensional Change Card Sort. Paired T-tests were examined to determine any subtle changes between time points that may have been obscured in the repeated measures ANCOVA. A significant improvement from pre-test to post-test 2 was observed for Dimensional Change Card Sort ($p < 0.05$). However, a significant decrease was observed from post-test 1 and post-test 2 for the Flanker ($p < 0.05$). None of the other comparisons revealed significant differences across time ($p > 0.05$ for all).

Table 4.7 T-Test – Executive Function

	Mean1 (SD)	Mean 2 (SD)	Mean 3 (SD)	Pre-test to Post-test1	Pre-test to Post-test2	Post-test1 to Post-test2
Flanker	66.8(20.77)	74.6(23.41)	69.6(22.78)	$T(4) = -1.43$, $p = 0.228$	$T(4) = -0.492$, $p = 0.648$	$T(4) = 3.95$, $p = 0.017$
DCCS	54.2(19.46)	64.4(36.94)	82.2(13.70)	$T(4) = -0795$, $p = 0.471$	$T(4) = -4.56$, $p = 0.010$	$T(4) = -1.57$, $p = 0.192$

Discussion

Fall Semester Outcomes

We quantified differences in health-related physical fitness, domains of perceived competence, and executive function of children with developmental disabilities resulting from a 10-week (2 x week) adapted gymnastics intervention. Fitness skills improved. Three out of six health-related fitness skills (isometric push-up, modified curl-up, and trunk lift) improved significantly after the 10-week intervention consistent with other adapted physical activity programs with larger sample sizes (Collins & Staples, 2017; Frangala-Pinkham et al., 2014). Indeed, the findings are also consistent with a previous gymnastics intervention for children with CP, in which improvements in upper body and abdominal muscular strength and range of motion were observed after 6-weeks (Cook et al., 2015). Improvements in the isometric push-up, modified curl-up, and trunk lift suggest that the participants gained important components necessary for postural stability as a result of the gymnastics program. Postural instability is common in children with developmental disabilities, particularly individuals with Down syndrome (Aly & Abonour, 2016) and cerebral palsy (Leineweber, Wyss, Dufour, Gane, Zabjek, Bouyer, Maltais, Voisin, & Andrysek, 2016). Postural stability may help participants maintain better balance when standing and sitting as well as prevent falls (Aly & Abonour, 2016); and perform desired movements in every day tasks at home and school (Leineweber et al., 2016).

Improvements in these fitness skills may also allow the participant to have greater independence and rely less on others to perform tasks.

Consistent with previous studies, we did not observe changes in participants' perceived physical, social, and cognitive competence scores following the 10-week intervention. These results are similar to Cook et al. (2015), in which a 6-week gymnastics intervention did not result in significant changes in physical self-perception (sports competence, physical conditioning, physical strength, and bodily attractiveness). With this said, a lack of changes across all participants in the current study may be due to within and between subjects heterogeneity of perceptions of competence. For example, although participant 1 (GYM001) exhibited relatively low cognitive and social perceived competence, this participant had reached ceiling levels for social perceived competence and these levels persisted across both the fall and spring semesters.

Recent community-based programs (Cook et al., 2015; Collins & Staples, 2017; Haney et al., 2014; Davis et al., 2011; Fragala-Pinkham et al., 2006) did not examine participants' executive function of attention, inhibition, and cognitive flexibility. Indeed, few studies have examined physical activity and executive function of children with developmental disabilities, particularly cerebral palsy (Maltais, Gane, Dufour, Wyss, Bouyer, McFadyen, Zabjek, Andrysek & Voisin, 2016) and Autism Spectrum Disorder (Memari, Mirfazeli, Kordi, Shayestehfar, Moshayedi & Mansournia, 2017). As hypothesized based on previous work with typically developing children, we observed improvements in one aspect of executive function, cognitive flexibility, following the 10-week intervention. The improvement in cognitive flexibility may be due to the use of activity stations. Participants rotated through the different stations to learn different skills, which required the participants to understand the demands/rules of each skill and

flexibly switch between skills for each station. Moreover, the adapted nature of each activity station allowed the children to challenge themselves in a way that was ability-appropriate.

Spring Semester Outcomes

All participants completed an additional 13-week follow-up intervention (1 x week) to determine the extent to which continued participation in the adapted gymnastics program would lead to sustained gains in fitness, perceived competence, and executive function. Although some children showed maintenance of skills, and some even showed continued improvements in skill, overall only the perceived cognitive competence variable showed a group-level improvement from pre-test to post-test 2. Two variables, Flanker and trunk lift, actually showed worse performance from post-test 1 to post-test 2, suggesting that the once a week intervention during the Spring semester was not sufficient to maintain these skills in children with developmental disabilities.

Differences in Fall and Spring Outcomes: Dose, Setting, and Participant Variability

The Fall and Spring semester programs produced different results and may be due in part to the total dose and frequency of the gymnastics program. The 10-week intervention consisted of 1-hour lessons offered twice a week (20 hours of gymnastics total). The 13-week program consisted of one session a week for 1 hour (13 hours of gymnastics total). Previous studies have also varied in total dose and frequency of participation. The gymnastics intervention implemented by Cook et al. (2015) consisted of 6 weeks, twice a week, for 1 hour (12 hours of gymnastics total), which was more consistent with the Fall program. As such, similar outcomes

were observed. Thus, it is possible that for reliable improvements to result from adapted gymnastics, the frequency of the program must be at least twice a week.

Another important consideration is the differences in the types of equipment available during the Fall and Spring semester programs. While the Fall semester program included one session at a gymnastics facility and provided opportunities to use different apparatuses (e.g., large uneven bars, floor, balance beam, vault, and trampoline), the other session was held at the Pediatric Movement and Physical Activity Lab and provided opportunities to develop fundamental movement activities using mats, balance boards, large foam wedges, a bar, low balance beams, scooters and other small equipment common in physical education classes. For the Spring semester, the program only had access to the equipment in the lab. It is possible that access to the equipment at the gymnastics facility was necessary to result in significant fitness improvements. Indeed, the previous adapted gymnastics intervention that reported changes across a broad range of skills and strength took place at a gymnastics facility and used similar apparatuses.

There are potential differences in within subject variability in the post-tests between the Fall and Spring semester programs. For example, it is unclear if the lack of improvements after the Spring program may have been affected by reduced participant motivation during post-test 2 (consistent with end of the school year behavior) or due to other aforementioned factors. Additional qualitative observations would be useful to determine the participant's motivation during theses assessments.

Limitations and Future Directions

The sample size for this study was small (n = 5). Transportation restrictions and recruitment difficulties precluded sufficient samples and the inclusion of a control group. For that reason, the participants were followed over two semesters to provide a better longitudinal evaluation of the effects of the intervention. With this said, the current results require replication with a larger sample of participation similarly followed longitudinally. Moreover, by increasing the number of participants with different developmental disabilities, quantification of specific differences in the effects of an adapted gymnastics intervention may be obtained.

Our intervention maintained a one-to-one, and in some cases two-to-one, volunteer participant ratio, in addition to adapted gymnastics instructors. This type of support may not be available in all communities. Volunteer recruitment and adequate training for volunteer is necessary for safe participation and the implementation of individually-specific modifications to the gymnastics activities. Future studies or practitioner-oriented articles will help provide guidance regarding the training of adapted instructors and additional supports needed to implement an adapted gymnastics program. In addition, future studies should examine the effects of the adapted programs on the perceptions of volunteers and coaches regarding the implementation of the programs and of individuals with disabilities.

Although it appears that access to gymnastics facilities may contribute to greater improvements in fitness and executive function, future studies or adapted gymnastics programs may not have the availability and access to these resources. In addition, memberships to gymnastics facilities may be cost-prohibitive for participants. Partnerships with community gymnastics facilities to defray costs and buy-in from coaches and staff are necessary to enable the development of sustainable and accessible community-based gymnastics programs.

References

Aly, S., & Abonour, A. (2016). Effect of core stability exercise on postural stability in children with Down syndrome. *International Journal of Medical Research & Health Sciences, 5, 10*, 213-222.

Bandini, L., Gleason, J., Curtin, C., Lividini, K., Anderson, S., Cermak, S., Maslin, M., & Must, A. (2013). Comparison of physical activity between children with autism spectrum disorders and typically developing children. *Autism, 17*, 44-54.

Capio, C., Sit, C., Abernethy, B., & Masters, R. (2012). Fundamental movement skills and physical activity among children with and without cerebral palsy. *Research in Developmental Disabilities, 33*, 1235-1241.

Collins, K., & Staples, K. (2017). The role of physical activity in improving physical fitness in children with intellectual and developmental disabilities. *Research in Developmental Disabilities, 69*, 49-60.

Cook, O., Frost, G., Twose, D., Wallman, L., Falk, B., Galea, V., Adkin, A., & Klentrou, P. (2015). CAN-flip: A pilot gymnastics program for children with cerebral palsy. *Adapted Physical Activity Quarterly, 32*, 349-370.

Davis, K., Zhang, G., & Hodson, P. (2011). Promoting health-related fitness for elementary students with intellectual disabilities through a specifically designed activity program. *Journal of Policy and Practice in Intellectual Disabilities, 8*, 77-84.

Diamond, A., & Ling, D. (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience, 18*, 34-48.

Ericsson, K.A., Nandagopal, K., Roring, R.W. (2009). Toward a science of exceptional achievement: Attaining superior performance through deliberate practice. *Annals of the New York Academy of Science, 1172 (1),* 199–217.

Fragala-Pinkham, M., Haley, S., & Goodgold, S. (2006). Evaluation of a community-based group fitness program for children with disabilities. *Pediatric Physical Therapy*, 159-167.

Haney, K., Messiah, S., Arheart, K., Hanson, E., Diego, A., Kardys, J., Kirwin, K., Nottage, R., Ramirez, S., Somarriba, G., & Binhack, L. (2014). Park-based afterschool program to improve cardiovascular health and physical fitness in children with disabilities. *Disability and Health Journal, 7*, 335-342.

Harter, S. (2012) Self-perception profile for children: Manual and questionnaires (Grades 3-8) Denver: University of Denver.

Harter, S., & Pike, R. (1983). The pictorial scale of perceived competence and social acceptance for young children. Denver: University of Denver.

Lakes, K.D., & Hoyt, W.T. (2004). Promoting self-regulation through school-based martial arts training. *Journal of Applied Developmental Psychology, 25*, 283–302.

Leineweber, M., Wyss, D., Dufour, S., Gane, C., Zabjek, K., Bouyer, L., Maltais, D., Voisin, J., & Andrysek, J. (2016). The effects of acute intense physical exercise on postural stability in children with cerebral palsy. *Adapted Physical Activity Quarterly, 33,* 271-282.

Maltais, D., Gane, C., Dufour, S., Wyss, D., Bouyer, L., McFadyen, B., Zabjek, K., Andrysek, J., & Voisin, J. (2016). Acute physical exercise affects cognitive functioning in children with cerebral palsy. *Pediatric Exercise Science, 28*, 304-311.

Memari, A., Mirfazeli, F., Kordi, R., Shayestehfar, M., Moshayedi, P., & Mansournia, M. (2017). Cognitive and social functioning are connected to physical activity behavior in

children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 33*, 21-28.

Murphy, N., Carbone, P., & the Council on Children with Disabilities (2008). Promoting the participation of children with disabilities in sports, recreation, and physical activities. *American Academy of Pediatrics, 121*, 1057-1061.

Staples, K., & Reid, G. (2010). Fundamental movement skills and autism spectrum disorders. *Journal of Autism and Developmental Disorders, 40*, 209-217.

Weintraub, S., Dikmen, S., Heaton, R., Tulsky, D., Zelazo, P., Bauer, P.,…Gershon, R. (2013). Cognition assessment using the NIH Toolbox. *American Academy of Neurology, 80*, 55-64.

Winnick, J.P. & Short, F. X. (2014). The Brockport physical fitness test (2nd ed.) Urbana: Sagamore Publishing

V. Conclusions

Overview

The overarching goal of this dissertation was to determine how to best structure an adapted gymnastics intervention for children with developmental disabilities, to not only enhance health-related physical fitness, executive function (EF), and perceived competence, but also to facilitate long-term physical activity participation. To gain insights on motivations of children and adolescents with cerebral palsy and other physical disabilities to participate in physical activity, a systematic review was conducted (Chapter II). The results of the systematic review suggested that children and adolescents were more likely to participate in physical activity with family members, friends, and individuals with similar disabilities. Participation in physical activity in school and outside of school were difficult due to motor limitations unless the activities were adapted to their abilities. Some individuals discovered that physical activity improved his/her strength and flexibility allowing him/her more independence. This enhanced independence served as additional motivator to continue participating in physical activities. In addition, social and physical competence also helped individuals continue participation in physical activity. Overall, the results from the systematic review helped inform the development of the adapted gymnastics intervention to enhance children's motivation to participate.

Chapter III provided the curriculum, modifications, and outcomes for each skill incorporated into the adapted gymnastics intervention. Special considerations were included to

ensure that the program was not only accessible across all ability levels such that each activity was considered age-and ability-appropriate while still challenging for each participant. The curriculum was designed to be implemented in a physical education setting or even an after-school community-based physical activity program for children and adolescents with disabilities. Different activities can be implemented in the curriculum that focus on fundamental movement skills as well as improving fitness. Pieces of the curriculum in chapter III originated from iCan Shine, a non-profit organization that provides adapted recreational activities to individuals with disabilities, in particular an adapted gymnastics program. A few of the skills, progressions and modifications were incorporated into the curriculum presented in Chapter III.

Chapter IV discussed the adapted gymnastics intervention with respect to the background, significance, methods, results, and implications. Although the aim of the study was to improve perceived competence (cognitive, physical, and social), executive function (EF), and health-related physical fitness through participation in this intervention, modest improvements in select outcomes were observed. For example, we found that as a group, the participants improved aspects of fitness related to postural control (isometric push-up, modified curl-up, and trunk lift) from pre-test to post-test during the Fall intervention. Postural stability is key in performing everyday tasks and participating in sports and recreation. Postural instability is common in children with developmental disabilities, particularly individuals with Down syndrome (Aly & Abonour, 2016) and cerebral palsy (Leineweber, Wyss, Dufour, Gane, Zabjek, Bouyer, Maltais, Voisin, & Andrysek, 2016). Greater postural stability would help achieve better balance when standing or sitting, prevent falls (Aly & Abonour, 2016), and increase performance of desired movements (Leineweber et al., 2016).

Interestingly, continued improvements in the health-related physical fitness domains related to postural control were not observed following the Spring intervention. And, no other improvements in the Fall or Spring intervention were observed for other aspects of fitness measured. The Fall and Spring semester interventions produced different results and may be due in part to the total dose and frequency of the gymnastics intervention. The 10-week intervention consisted of 1-hour lessons offered twice a week (20 hours of gymnastics total). The 13-week program consisted of one session a week for 1 hour (13 hours of gymnastics total). Thus, it is possible that for reliable improvements to result from adapted gymnastics, the frequency of the intervention must be at least twice a week.

Improving health-related physical fitness (i.e., muscular strength, muscular endurance, and flexibility) would help participants to be more successful in activities of daily living, increase independence, and increase the participation in physical activity, sport, and recreational programs. However, we did not directly measure changes in the ability to perform activities of daily living, functional independence or increased participation in other sport and recreation programs after the intervention. Future studies would be needed to relate changes observed during the gymnastics intervention and the generalizability of movement abilities outside the gymnastics setting.

With respect to perceived competence, the only finding worth noting is the increase in cognitive perceived competence observed from pre-test to post-test 2 (i.e., after the Spring intervention). It is unclear, however, if this change is due to the adapted gymnastics intervention or due to changes across a full school year. A waitlist control group would be needed to determine if the changes observed in cognitive competence are uniquely due to the adapted gymnastics intervention.

With respect to executive function (EF), significant improvements were observed for the Dimensional Card Sort from pre-test to post-test 2 (i.e., after the Spring intervention). It is unclear however, if this change is due to the adapted gymnastics intervention or due to changes across a full school year. Again, a waitlist control group would be needed to determine if changes in executive function are uniquely due to the adapted gymnastics intervention. With this said, these results will be able to add to the literature that EF does improve in children with disabilities when participating in an adapted gymnastics intervention of this kind. Indeed, we predicted this type of improvement because the intervention was designed in such a way to provide a challenge for every child and provide a variety of activities. Switching from one task to the next and understanding the demands of each task may have aided in the improvement in cognitive flexibility observed in the present study.

Taken together, the study presented in Chapter IV provides evidence that continued participation in programs within the community that are fun, feasible and accessible are needed to improve and maintain physical fitness, competence, and executive function for children with developmental disabilities.

Limitations and Future Directions

There are several limitations that should be noted. First, our sample size was small (n = 5). We recruited for a total of 4-weeks with the aid of service providers of families with developmental disabilities (e.g., special education teachers, clinicians, therapeutic recreation programs) as well as from past participation in research and outreach programs in the Pediatric Movement and Physical Activity Lab. After 4-weeks of recruitment, we were able to recruit a total of 5 participants with developmental disabilities. Transportation restrictions and recruitment

difficulties precluded sufficient samples and the inclusion of a control group. For that reason, the participants were followed over two semesters to provide a better longitudinal evaluation of the effects of the intervention. With this said, the current results require replication with a lager sample of participants similarly followed longitudinally. Moreover, by increasing the number of participants with different developmental disabilities, quantification of disability-specific differences in the effects of an adapted gymnastics intervention may be obtained.

Second, the current analysis did not take into account absences. So, some participants may have completed more sessions than others (i.e., increased dose). In addition, some participants may have attended the session, but had behavioral problems that reduced the amount of participation or motivation for participating.

Third, the change in number of sessions and the setting may have contributed to differences in the intervention outcomes from the Fall and Spring. Greater number of sessions per week and access to the equipment at gymnastics facilities may have influenced the results.

Implications

Several studies have examined changes in health-related physical fitness through participation in community-based physical activity programs/interventions in children with developmental disabilities (Collins & Staples, 2017; Cook, Frost, Twose, Wallman, Falk, Galea, Adkin, & Klentrou, 2015; Haney, Messiah, Arheart, Hanson, Diego, Kardys, Kirwin, Nottage, Ramirez, Somarriba & Binhack, 2014; Davis, Zhang & Hodson, 2011; Fragala-Pinkham, Haley & Goodgold, 2006). Our study adds to the existing literature by not only examining health-related physical fitness and perceived competence, but also executive function in individuals with developmental disabilities. This work also helped us to identify important potential barriers for continued implementation of the adapted gymnastics intervention in the community including

facilities, trained coaches and volunteers, recruiting participants, costs, and transportation. These barriers need to be addressed in order to implement interventions/programs for individuals with disabilities to achieve similar outcomes as those reported presently.

REFERENCES

Aly, S., & Abonour, A. (2016). Effect of core stability exercise on postural stability in children with Down syndrome. *International Journal of Medical Research & Health Sciences, 5, 10*, 213-222.

Bandini, L., Gleason, J., Curtin, C., Lividini, K., Anderson, S., Cermak, S., Maslin, M., & Must, A. (2013). Comparison of physical activity between children with autism spectrum disorders and typically developing children. *Autism, 17*, 44-54.

Baio J., Wiggins L., Christensen D., et al. (2018). Prevalence of autism spectrum disorder among children aged 8 years — autism and developmental disabilities monitoring network, 11 sites, United States, 2014. Surveillance Summaries, 67, 1–23.

Bize, R., Johnson, J., & Plotnikoff, R. (2007). Physical activity level and health-related quality of life in the general adult population: A systematic review. *Preventive Medicine, 45*, 401-415.

Bjornson, K., Belza, B., Kartin, D., Logsdon, R., & McLaughlin, J. (2007). Ambulatory physical activity performance in youth with cerebral palsy and youth who are developing typically. *Physical Therapy, 87*, 248-257.

Bloemen, M., Backx, F., Takken, T., Wittink, H., Benner, J., Mollema, J., & De Groot, J. (2014). Factors associated with physical activity in children and adolescents with a physical disability: A systematic review. *Developmental Medicine & Child Neurology, 57*, 137-148.

Boyle, C., Boulet, S., Schieve, L., Cohen, R., Blumberg, S., Yeargin-Allsopp, M., Visser, S., & Kogan, M. (2011). Trends in the prevalence of developmental disabilities in US children, 1997–2008. *Pediatrics, 127*, 1034–1042.

Bult, M., Verschuren, O., Jongmans, M. Lindeman, E., & Ketelaar, M. (2011). What influences participation in leisure activities of children and youth with physical disabilities? A systematic review. *Research in Developmental Disabilities, 32*, 1521-1529.

Capio, C., Sit, C., Abernethy, B., & Masters, R. (2012). Fundamental movement skills and physical activity among children with and without cerebral palsy. *Research in Developmental Disabilities, 33*, 1235-1241.

Carlon, S., Taylor, N., Dodd, K., & Shields, N. (2013). Differences in habitual physical activity levels of young people with cerebral palsy and their typically developing peers: a systematic review. *Disability & Rehabilitation, 35*, 647-655.

Collins, K., & Staples, K. (2017). The role of physical activity in improving physical fitness in children with intellectual and developmental disabilities. *Research in Developmental Disabilities, 69*, 49-60.

Columna, L., Pyfer, J., & Senne, T. (2011). Physical recreation among immigrant Hispanic families with children with disabilities. *Therapeutic Recreational Journal, 45*, 214-233.

Conchar, L., Bantjes, J., Swartz, L., & Derman, W. (2016). Barriers and facilitators to participation in physical activity: The experiences of a group of South African adolescents with cerebral palsy. *Journal of Health Psychology, 21*, 152-163.

Cook, O., Frost, G., Falk, B., Adkin, A., Klentrou, P., Twose, D., Wallman, L., & Galea, V. (2015) Can-flip: A pilot gymnastics program for children with cerebral palsy. *Adapted Physical Activity Quarterly, 32*, 349-370.

Danhan-Oliel, N., Shikako-Thomas, K., & Majnemer, A. (2012). Quality of life and leisure participation with neurodevelopmental disabilities: A thematic analysis. *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care, and Rehabilitation, 21*, 427-439.

Davis, K., Zhang, G., & Hodson, P. (2011). Promoting health-related fitness for elementary students with intellectual disabilities through a specifically designed activity program. *Journal of Policy and Practice in Intellectual Disabilities, 8*, 77-84.

Diamond, A., & Ling, D. (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience, 18*, 34-48.

Durstine, J., Painter, P., Franklin, B., Morgan, D., Pitetti, K., & Roberts, S. (2000). Physical activity for the chronically ill and disabled. *Sports medicine, 30*, 207-219.

Ericsson, K.A., Nandagopal, K., Roring, R.W. (2009). Toward a science of exceptional achievement: Attaining superior performance through deliberate practice. *Annals of the New York Academy of Science, 1172 (1),* 199–217.

Fernandez, Y., Ziviani, J., Cuskelly, M., Colquhoun, R., & Jones, F. (2018). Participation in community leisure programs: Experiences and perspectives of children with developmental difficulties and their parents. *Leisure Science, 40*, 110-130.

Fragala-Pinkham, M., Haley, S., & Goodgold, S. (2006). Evaluation of a community-based group fitness program for children with disabilities. *Pediatric Physical Therapy*, 159-167.

Haney, K., Messiah, S., Arheart, K., Hanson, E., Diego, A., Kardys, J., Kirwin, K., Nottage, R., Ramirez, S., Somarriba, G., & Binhack, L. (2014). Park-based afterschool program to

improve cardiovascular health and physical fitness in children with disabilities. *Disability and Health Journal, 7*, 335-342.

Harter, S. (2012) Self-perception profile for children: Manual and questionnaires (Grades 3-8) Denver: University of Denver.

Harter, S., & Pike, R. (1983). The pictorial scale of perceived competence and social acceptance for young children. Denver: University of Denver.

Hartman, E., Smith, J., Westendorp, M., & Visscher, C. (2015). Development of physical fitness in children with intellectual disabilities. *Journal of Intellectual Disability Research, 59*, 439–449

iCan Shine, Inc. (2018). Retrieved from https://icanshine.org/

Imms, C. (2008). Children with cerebral palsy participate: A review of the literature. *Disability and Rehabilitation, 30,* 1867-1884.

Imms, C., Reilly, S., Carlin, J., & Dodd, K. (2009). Characteristics influencing participation in Australian children with cerebral palsy. *Disability and Rehabilitation, 31*, 2204-2215.

Knibbe, T., Biddiss, E., Gladstone, B., & McPherson, A. (2017). Characterizing socially supportive environments relating to physical activity participation for young people with physical disabilities. *Developmental Neurorehabilitation, 20*, 294-300.

Lakes, K.D., & Hoyt, W.T. (2004). Promoting self-regulation through school-based martial arts training. *Journal of Applied Developmental Psychology, 25*, 283–302.

Lauruschkus, K., Nordmark, E., & Hallstrom, I. (2015). "It's fun but…" Children with cerebral palsy and their experiences of participation in physical activities. *Disability and Rehabilitation, 37,* 283-289.

Lauruschkus, K., Nordmark, E., & Hallstrom, I. (2017). Parents' experiences of participation in physical activities for children with cerebral palsy-protecting and pushing towards independence. *Disability and Rehabilitation, 39*, 771-778.

Law, M., King, G., King, S., Kertoy, M., Hurley, P., Rosenbaum, P., Young, N., & Hanna, S. (2006). Patterns of participation in recreational and leisure activities among children with complex physical disabilities. *Developmental Medicine, 48*, 337-342.

Leineweber, M., Wyss, D., Dufour, S., Gane, C., Zabjek, K., Bouyer, L., Maltais, D., Voisin, J., & Andrysek, J. (2016). The effects of acute intense physical exercise on postural stability in children with cerebral palsy. *Adapted Physical Activity Quarterly, 33,* 271-282.

Li, C., & Chen, S. (2012). Exploring experiences of physical activity in special students with cerebral palsy: A qualitative perspective. *European Journal of Adapted Physical Activity, 5,* 7-17.

Maenner, M., Blumberg, S., Kogan, M., Christensen, D., Yeargin-Allsopp, M., & Schieve, L. (2016). Prevalence of cerebral palsy and intellectual disability among children identified in two U.S. National surveys, 2011-2013. *Annals Epidemiology, 26*, 222-225.

Maher, C., Williams, M., Olds, T., & Lane, A. (2007). Physical and sedentary activity in adolescents with cerebral palsy. *Developmental Medicine & Child Neurology, 49,* 450-457.

Majnemer, A., Shevell, M., Law, M., Birnbaum, R., Chilingaryan, G., Rosenbaum, P., & Poulin, C. (2008). Participation and enjoyment of leisure activities in school-aged children with cerebral palsy. *Developmental Medicine & Child Neurology, 50*, 751-758.

Majnemer, A., Shikako-Thomas, K., Chokron, N., Law, M., Shevell, M., Chilingaryan, G., & Rosenbaum, P. (2009). Leisure activity preferances for 6- to 12-year-old children with cerebral palsy. *Developmental Medicine & Child Neurology, 52*, 167-173.

Majnemer, A., Shikako-Thomas, K., Schmitz, N., Shevell, M., & Lach, L. (2015). Stability of leisure participation from school-age to adolescence in individuals with cerebral palsy. *Research in Developmental Disabilities, 47,* 73-79.

Maltais, D., Gane, C., Dufour, S., Wyss, D., Bouyer, L., McFadyen, B., Zabjek, K., Andrysek, J., & Voisin, J. (2016). Acute physical exercise affects cognitive functioning in children with cerebral palsy. *Pediatric Exercise Science, 28*, 304-311.

Memari, A., Mirfazeli, F., Kordi, R., Shayestehfar, M., Moshayedi, P., & Mansournia, M. (2017). Cognitive and social functioning are connected to physical activity behavior in children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 33*, 21-28.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, DG. The PRISMA Group (2009). *Preferred Reporting Items for Systematic Reviews and Meta-Analyses:* The PRISMA Statement. BMJ 2009;339:b2535,

Moraru, C., Mihaela, H., & Dumitru, V. (2014). The role of gymnastics and dance in rehabilitating motor capacities in children with down syndrome. *Journal of Physical education, Sports and Related Sciences, 14*, 102-112.

Murphy, N., Carbone, P., & the Council on Children with Disabilities. (2008). Promoting the participation of children with disabilities in sports, recreation, and physical activities. *Pediatrics, 121*, 1057-1061. doi:10.1542/peds.2008-0566

Palisano, R., Chiarello, L., Orlin, M., Oeffinger, D., Polansky, M., Maggs, J., Bagley, A., & Gorton, G. (2010). Determinants of intensity of participation in leisure and recreational activities by children with cerebral palsy. *Developmental Medicine & Child Neurology, 53*, 142-149.

Parker, S., Mai, C., Canfield, M., Rickard, R., Wang, Y., Meyer, R., Anderson, P., Mason, C., Collins, J., Kirby, R., & Correa, A. (2010). Updated national birth prevalence estimates for selected birth defects in the United States, 2004-2006. *Birth Defects Research (Part A), 88*, 1008-1016.

Powrie, B., Kolehmainen, N., Turpin, M., Ziviani, J., & Copley, J. (2015). The meaning of leisure for children and young people with physical disabilities: A systematic evidence synthesis. *Developmental Medicine & Child Neurology, 57*, 993-1010.

Rimmer, J., & Rowland, J. (2008). Physical activity for youth with disabilities: A critical need in an undeserved population. *Developmental Neurorehabilitation, 11*, 141-148.

Rosenbaum, P., & Gorter, J. (2012). The 'F-words' in childhood disability: I swear this is how we should think! *Child: Care, Health, and Development, 38*, 457-463.

Sandlund, M., Waterworth, E., & Hager, C. (2011). Using motion interactive games to promote physical activity and enhance motor performance in children with cerebral palsy. *Developmental Neurorehabilitation, 14*, 15-21.

Sandlund, M., Dock, K., Hager, C., & Waterworth, E. (2012). Motion interactive video games in home training for children with cerebral palsy: Parents' perceptions. *Disability and Rehabilitation, 34*, 925-933.

Shakiko-Thomas, K., Majnemer, A., Law, M., & Lach, L. (2008). Determinants of participation in leisure activities in children and youth with cerebral palsy: A systematic review. *Physical & Occupational Therapy in Pediatrics, 28*, 155-169.

Shields, N., Loy, Y., Murdoch, A., Taylor, N., & Dodd, K. (2007). Self-concept of children with cerebral palsy compared with that of children without impairment. *Developmental Medicine & Child Neurology, 49*, 350-354.

Staples, K., & Reid, G. (2010). Fundamental movement skills and autism spectrum disorders. *Journal of Autism and Developmental Disorders, 40*, 209-217.

Stodden, D., Goodway, J., Langendorfer, S., Roberton, M., Rudisill, M., Garcia, C., & Garcia, L. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest, 60*, 290-306.

Telema, R., Yang, X., Viikari, J., Valimaki, I., Wanne, O., & Raitakari, O. (2005). Physical activity from childhood to adulthood: A 21-year tracking study. *American Journal of Preventative Medicine, 28,* 267-273.

Tollerz, L., Forslund, A., Olsson, R., Lidstrom, H., & Holmback, U. (2015). Children with cerebral palsy do not achieve healthy physical activity levels. *Acta Paediatrica, 104*, 1125-1129.

van Eck, M., Dallmeijer, A., Beckerman, H., van den Hoven, P., Voorman, J., & Becher, J. (2008). Physical activity level and related factors in adolescents with cerebral palsy. *Pediatric Exercise Science, 20,* 95-106.

Verschuren, O., Wiart, L., Hermans, D., & Ketelaar, M. (2012). Identification of facilitators and barriers to physical activity in children and adolescents with cerebral palsy. *The Journal of Pediatrics, 161*, 488-494.

Weintraub, S., Dikmen, S., Heaton, R., Tulsky, D., Zelazo, P., Bauer, P.,…Gershon, R. (2013). Cognition assessment using the NIH Toolbox. *American Academy of Neurology, 80*, 5 64.

Whitt-Glover, M., O'Neill, K., & Stettler, N. (2006). Physical activity patterns in children with and without down syndrome. *Pediatric Rehabilitation, 9*, 158–164.

Willis, C., Girdler, S., Thompson, M., Rosenberg, M., Reid, S., & Elliott, C. (2017). Elements contributing to meaningful participation for children and youth with disabilities: A scoping review. *Disability and Rehabilitation, 39*, 1771-1784.

Winnick, J.P. & Short, F. X. (2014). The Brockport physical fitness test (2nd ed.) Urbana: Sagamore Publishing

World Health Organization. (2013). How to use the ICF: A practical manual for using the International Classification of Functioning, Disability and Health (ICF).

World Health Organization. (2010). Global Recommendations on Physical Activity for Health. (p.16). Geneva: WHO Press.

World Health Organization. (2010). Global Recommendations on Physical Activity for Health. (p.18). Geneva: WHO Press.

Zwier, J., van Schie, P., Becher, J., Smits, D., Gorter, J., & Dallmeijer, A. (2010). Physical activity in young children with cerebral palsy. *Disability and Rehabilitation, 32*, 1501-1508.

APPENDIX A: Approved IRB

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(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS AN APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

PARENTAL PERMISSION/PARENTAL CONSENT
For a Research Study entitled

"Improving Perceived Competence, Motor and Cognitive Skills of Children with Developmental Disabilities through an Adapted Gymnastics program"

Your child is invited to participate in a research study to improve your child's motor skills, perceived competence, and cognitive skills through an adapted gymnastics program. The study is being conducted by Claire Bridges (Graduate Teaching Assistant) under the direction of Dr. Melissa Pangelinan (Assistant Professor) and Dr. Mary Rudisill (Director) in the School of Kinesiology at Auburn University. Your son or daughter is invited to participate in the research study because:

- Your child is between the ages of 5-12 years and has been diagnosed with Down syndrome or cerebral palsy (i.e., spastic hemiplegia, diplegia, and quadriplegia) and is able to walk independently or assistance with canes or walker.
- Your child does not have any of the following: heart, blood pressure, seizures, concussion, blindness, or major surgery or botox injections within the last 3 to 6 months.
- Participating in physical activity should not put your child's health or well-being at risk.
    - Your child has received clearance from physician with a signed letter to participate in the adapted gymnastics program.

What will be involved if your child participates? The research study is a total of 14-weeks. Pre- and post-testing (2 sessions lasting between 2-3.5 hours) will take place at the Pediatric Movement and Physical Activity Lab (024 School of Kinesiology) up to two weeks prior to (August) and following the adapted gymnastics program (December). Your child will be assessed on gross motor skills, cognitive skills, and their perceived competence. The following tests will be assessed: a) Challenge Module or GMFM (45-60 minutes) and Brockport Physical Fitness Test (2o minutes); b) cognitive skills: NIH Toolbox for Assessment of Neurological and Behavioral Function: iPad App Version 1.7 (30 minutes); c) Harter's Pictorial Scale of Perceived Competence (10-15 minutes) or Self-Perception Profile for Children (15-20 minutes); d) d) balance and range of motion (5 minutes); e) Puberty for Children Questionnaire – ages 9+ (5-10 minutes). The researcher would like for parent and participant (child) to participate in an interview session answering questions regarding the effectiveness of the adapted gymnastics program during the post-test session.
Interviews will last a total of 30 minutes; therefore, the post-test session would be a duration of 2-3.5 hours. During the pre-post testing of the assessments your child will be video recorded. Video recording is for the researchers to be able to review the assessments and reevaluate for scoring purposes. Parents will receive reports from the assessments from the pre-post testing and a weekly gymnastics skills checklist from the adapted gymnastics program.

Parent/Guardian Initials_____

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The adapted gymnastics program is a 10-week program. The program was developed by iCanShine, a nonprofit organization that provides recreational activities for children with disabilities. ICanShine has provided this program for children with disabilities for 5 years. The adapted gymnastics program consists of 1-hour sessions twice a week for fall 2017 (September, October, and November) or spring 2018 (January, February, and March). One session will be at the Auburn Gymnastics Academy for the use of apparatuses, and one session will be in the Pediatric Movement and Physical Activity Lab for stretching, strength, and tumbling. Activities will include the use of gymnastics equipment, mats, and other forms of equipment for skills that will increase strength, balance, and flexibility to help improve perceived competence, motor skills and cognitive skills in children with cerebral palsy and Down syndrome. All activities and skills have been adapted for children with developmental disabilities. Gymnastics coaches from Auburn Gymnastics Academy will be assisting and spotting children in all gymnastics skills at Auburn Gymnastics Academy. Volunteers will also assist children in rotating to the different events and providing encouragement. Claire Bridges (Principle Investigator) will be lead instructor on the day the session is in the Pediatric Movement and Physical Activity Lab. She has coached recreational gymnastics for 7 years (2008-2015) in Montgomery with experience in working with children that have developmental disabilities. Claire Bridges is also a USAG certified instructor and trained in safety. Volunteers will assist as well as other individuals that are trained/experienced in spotting and safety in the sport of gymnastics. Seating will be available at both facilities for you to observe your child during the 1-hour session of the adapted gymnastics program.

Are there any risks or discomforts? Your child may experience muscle soreness, fatigue, and frustration during the assessments and adapted gymnastics program. To minimize these risks your child will be encouraged to take breaks during the assessments and program. All personnel will be aware of positive behavioral supports (i.e., praise, encouragement, providing breaks when necessary) to reduce frustration. The physical activities in the assessments and the adapted gymnastics program are similar to sports and recreational activities. The risk of falls during the adapted gymnastics program will be minimized with proper spotting and assisting from gymnastics coaching. Volunteers will assist children in rotating to the different events during the program and walking on uneven surfaces (e.g., gymnastics floor and mats).

Are there any costs to participating? Participation in the research study is no cost to you and your child. In the unlikely event that your child may sustain an injury from participation in the study, the investigators have no current plans to provide funds for any medical expenses or other costs you may incur.

Are there any benefits to your child or others? The design of the study is to improve/increase the strength, balance, coordination, and flexibility of participants through the sport of gymnastics. The program may also increase confidence, competence, and social well-being. You and your child are free to ask questions anytime during the study, and your child may withdraw from participation in the study at any time without penalty. You will be given a signed copy of this consent form.

If you change your mind about your child participating, you or your child can withdraw from the study at any time. His/her participation is completely voluntary. If you or your child choose to withdraw, his/her data as well as your data from the interview as long as it is identifiable. Your decision about whether or not to allow your child to participate or to stop participating will not jeopardize his/her future relations with Auburn University or the School of Kinesiology.

Parent/Guardian Initials _____

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Your child's privacy will be protected. Any information obtained for this study is strictly confidential and your child's name will not be identified on any data. The data collected will be stored on a password-protected computer and a locked file cabinet. The principal investigator and Dr. Pangelinan will be the only people to have access to the data. Your child's information may be shared with representatives of Auburn University and government authorities if required by law.

If you or your child have questions about this study, *please ask them now* or contact Claire Bridges at ceb0085@auburn.edu or by phone at 334-844-1548. You may also contact Dr. Melissa Pangelinan at mgp0020@auburn.edu or by phone 334-744-4142. A copy of this document will be given to you to keep. **If you have questions about your child's rights as a research participant,** you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH FOR YOUR CHILD TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO ALLOW HIM OR HER TO PARTICIPATE.

Permission for Child to Participate in Study and Post-Study Interview

_____
Child's Name

_____ _____
Parent/Guardian Name Date

_____ _____
Parent/Guardian Signature Date

Parental Informed Consent for Participation in Post-Study Interview

_____ _____
Parent/Guardian Name Date

_____ _____
Parent/Guardian Signature Date

_____ _____ _____
Investigator Obtaining Consent Investigator's Signature Date

Parent/Guardian Initials _____

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VIDEO RELEASE – CHILD

During your child's participation in this research study, "**Improving Perceived Competence, Motor and Cognitive skills of Children with Developmental Disabilities through an Adapted Gymnastics Program**", your child will be videotaped. Your signature on the Informed Consent gives us permission to do so.

Your signature on this document gives us permission to use the videotape(s) for the additional purposes of publication, training, and presentation beyond the immediate needs of this study. These videotapes will not be destroyed at the end of this research but will be retained 3 years upon completion of the study

Your permission:

I give my permission for videotapes produced in the study, "Improving Perceived Competence, Motor and Cognitive skills in Children with Developmental Disabilities through an Adapted Gymnastics Program", which contain images of my child, to be used for the purposes listed above, and to also be retained for 3 years upon completion of the study.

_____
Child's Name

_____ _____
Parent's Signature Investigator's Signature

_____ _____
Printed Name Date Printed Name Date

The Auburn University Institutional
Review Board has approved this
Document for use from
08/29/2017 to 03/21/2018
Protocol # 17-038 MR 1708

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MINOR ASSENT
Verbal Script for ages 5-7 years
for a research study entitled
"Improving Perceived Competence, Motor and Cognitive Skills of Children with Developmental Disabilities through an Adapted Gymnastics Program"

You (*and your parents or guardian(s)*) are invited to be in a research study. We want to know how gymnastics helps children move and think.

If you want to be in the study you will come to our lab. You will play games that helps us know how you move and think. You will do a gymnastics program twice a week for an hour. You will come back to the lab and play our games again.

Some of the time that you are playing our games in our lab, we will have a movie camera on, taking a video of you. We can only make the video if you and your parent(s) or guardian say it's ok to do that.

When you are playing our games or gymnastics program your body may feel sore, tired, and may get upset. Your gym coaches and Claire Bridges will make sure you take breaks. You can ask for breaks at any time.

You can stop at any time. Just tell your parents or Claire Bridges if you do not want to play our games or be a part of the gymnastics program. No one will be angry with you if you stop.

If you have any questions about what you will do or what will happen, please ask your parents or guardian or ask Claire Bridges now. If you

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have questions while you are playing our games or a part of the gymnastics program we want you to ask us.

Do you want to be in our study?

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MINOR ASSENT
Ages 8-12 years
for a research study entitled
"Improving Perceived Competence, Motor and Cognitive Skills of Children with Developmental Disabilities through an Adapted Gymnastics Program"

You (*and your parents or guardian(s)*) are invited to be in a research study to help us understand how gymnastics helps children move and think.

If you decide you want to be in this study, you will come to our lab and play movement and thinking games that help us know how you move and think. You will then do a gymnastics program twice a week for an hour. At the end of the study you will come back to the lab and play our movement and thinking games again.

Some of the time that you are playing the movement and thinking games in our lab, we will have a movie camera on, taking a video of you. We need the video to study later, after you go home. We can only make the video if you and your parent(s) or guardian give us permission to do that.

During the movement and thinking games or gymnastics program your body may feel sore, tired, and may get frustrated. Your gym coaches and Claire Bridges will make sure you take breaks. You can ask for breaks at any time.

You can stop at any time. Just tell your parents or Claire Bridges if you don't want to play our games or be a part of the gymnastics program any more. No one will be angry with you if you stop.

If you have any questions about what you will do or what will happen, please ask your parents or guardian or ask Claire Bridges now. If you have questions while you are playing our games or a part of the gymnastics program we want you to ask us.

If you have decided to help us, please sign or print your name on the line below.

Child's Signature	Printed Name	Date
Parent/Guardian Signature	Printed Name	Date

(Parent/Guardian must also sign Parent/Guardian Permission form!)

Investigator obtaining consent	Printed Name	Date

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School of Kinesiology – Auburn University

MOVEMENT. HEALTH. PERFORMANCE.

Dear Parents,

Thank you for your interest in our research study titled, "Improving Perceived Competence, Motor and Cognitive Skills of Children with Developmental Disabilities through an Adapted Gymnastics Program". This letter provides additional information about our research study in the School of Kinesiology at Auburn University. The research study focuses on helping your child improve their perceived competence as well as their motor and cognitive skills through an adapted gymnastics program. We also hope your child will want to continue physical activity after the research study.

Your child is eligible for the research study:

- **Your child is between the ages of 5-12 years and diagnosed with Down syndrome or cerebral palsy (i.e., spastic hemiplegia, diplegia, and quadriplegia), and able to walk independently as well as assistance with canes or walker.**

The research study is a total of 14-weeks. Pre-post testing (2 sessions- one for pre-testing 2-3 hours and one for post-testing-2-3.5 hours, includes interview) will take place up to two weeks before (August) and two weeks after the adapted gymnastics program (December) in the Pediatric Movement and Physical Activity Lab (024 School of Kinesiology). Your child will complete assessments on gross motor skills, cognitive skills, and their perceived competence. The following tests will be assessed: a) Challenge Module or GMFM (45-60 minutes) and Brockport Physical Fitness Test (20 minutes); b) cognitive skills: NIH Toolbox for Assessment of Neurological and Behavioral Function: iPad App Version 1.7 (30 minutes); c) Harter's Pictorial Scale of Perceived Competence (10-15 minutes) or Self-Perception Profile for Children (15-20 minutes); d) balance and range of motion (5 minutes); e) Puberty for Children Questionnaire – ages 9+ (5-10 minutes).

You and your child will be asked if either of you or both would participate in an interview session answering questions regarding the effectiveness of the program. The interview session will be during the post-testing session for a duration of 30 minutes; therefore, the post-test session is 2-3.5 hours instead of 2-3 hours in length. During the pre-post testing of the assessments your child will be video recorded. Video recording is for the researchers to be able to review the assessments and reevaluate for scoring purposes.

The adapted gymnastics program is a 10-week intervention either fall 2017 (September-November) or spring 2018 (January-March). ICanShine, a nonprofit organization that provides recreational activities for children with disabilities created the curriculum for the adapted gymnastics program. ICanShine has provided this program for children with disabilities for 5 years. The adapted gymnastics program consists of 1-hour sessions twice a week. Activities will include the use of gymnastics equipment, mats, and other forms of equipment for skills that will increase strength, balance, coordination, and flexibility and are adapted to meet the needs of children with developmental disabilities. One session will be at the Auburn Gymnastics Academy for the use of apparatuses and one session will be in the Pediatric Movement and

Physical Activity Lab for stretching, strength, and tumbling. Gymnastics coaches at the Auburn Gymnastics Academy will be assisting and spotting children in all gymnastics skills. All coaches are trained in safety and spotting. Volunteers will also assist children in rotating to the different events and providing encouragement. Claire Bridges (Principle Investigator) will be lead instructor on the day the session is held at the Pediatric Movement and Physical Activity Lab. She coached recreational gymnastics for 7 years (2008-2015) in Montgomery with experience in working with children with developmental disabilities. Claire Bridges is also a USAG certified instructor and trained in safety. Volunteers will assist as well as other individuals that are trained/experienced in spotting and safety in the sport of gymnastics.

Participating in the research study is optional and is no cost to you. Your child does not have to participate in the adapted gymnastics program part of the study, although we would like your child to be a part of this program. Seating is available at Auburn Gymnastics Academy and Pediatric Movement and Physical Activity Lab for you to observe your child during the 1-hour session of the adapted gymnastics program.

The design of the study is to benefit the participants by helping them gain strength, balance, flexibility, range of motion and improve coordination through the sport of gymnastics. The adapted gymnastics program is also to help instill confidence, competence, and social well-being child while participating in physical activity in children with developmental disabilities. You may receive reports on the motor and cognitive skill assessments as well as perceived competence and weekly reports of gymnastics skills from the adapted gymnastics program.

To be sure that your child is eligible for the study you will be asked some questions about your child's general health and individuals with cerebral palsy will be asked a few additional questions as well as questions regarding physical activity. You will also find a letter to your child's physician along with this additional information. We want to make sure we cover all precautions of your child participating in the research study. **Your child must receive clearance from your physician if there is reason to believe that participation in physical activity will put your child's health and well-being at risk.** The letter to your child's physician details the amount of activity your child will be participating in for the research study.

If interested in your child participating in the research study please contact Claire Bridges at ceb0085@auburn.edu or by phone at 334-844-1548.

APPENDIX B: Flyer

The Auburn University Institutional Review Board has approved this Document for use from 08/29/2017 to 03/21/2018 Protocol # 17-038 MR 1708

MOVEMENT. HEALTH. PERFORMANCE.

The School of Kinesiology at Auburn University invites your child to participate in a research study about improving perceived competence, motor, and cognitive skills through an adapted gymnastics program

- Is your child between the ages of 5-12 years old and has a diagnosis of Down syndrome or cerebral palsy (spastic hemiplegia, diplegia, and quadriplegia)?
- Is your child able to walk independently, assistance with canes or walker?
- Research study is a total of 14-weeks
  - 4 weeks for pre-testing and post-testing- 2 weeks in August (pre-test) and 2 weeks in December (post-test) – Schedule one session in August and December.
  - Each testing session will be between a total of 2-3 (pre-test) or 2-3.5 hours (post-test). Post-test session includes interviews with parent and participant for a duration of 30 minutes.
  - 10 weeks (twice a week) - Adapted Gymnastics Program- starting either Fall 2017 (September, October, and November) or Spring 2018 (January, February, and March)
- Participation will include:
  - Gross motor activities
  - Fun brain games on the iPad
  - Assessing perceived competence
  - An adapted gymnastics program

What we will ask you to do:

- Before the study, we will ask you to answer a few questions about your child's general health and few additional questions for individuals with cerebral palsy for eligibility in the study.
- If eligible, you will complete consent forms (permission) and will receive additional information about the program.
- Your child will complete assessments (pre/post) in the Pediatric Movement and Physical Activity Lab at the School of Kinesiology (once in August and once in December).
- Your child will participate in an adapted Gymnastics Program for 10-weeks (twice a week).
- You will receive your child's assessment scores and gymnastics skills checklist each week during the program.

PLEASE CONTACT:

CLAIRE BRIDGES at

ceb0085@auburn.edu or

(334) 844-1548 for MORE INFORMATION

APPENDIX C: Health History Form and Child PAR-Q

Appendix B

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

MOVEMENT. HEALTH. PERFORMANCE.

Health History Form – Child

Parent's Name: _____

Child's Name: _____ Child's Sex: ☐ Male ☐ Female

Child's Date of Birth: _____

Health History - General

Yes	No	Condition
☐	☐	1. Heart disease/heart defect/high blood pressure
☐	☐	2. Chest pain
☐	☐	3. Seizures/epilepsy/fainting spells
☐	☐	4. Concussion or serious head injury
☐	☐	5. Blindness/visual problems
☐	☐	6. Major surgery in the last 3-6 months

Health History - Cerebral Palsy

Yes	No	Condition
☐	☐	7. Has your child received a diagnosis from a physician or physical therapist of cerebral palsy? If so, what type: _____?
☐	☐	8. Can your child walk independently or with assistance from canes or a walker?
☐	☐	9. Botox injections 3-6 months

Eligibility Criteria:
Responded "No" for Questions 1-6 and 9.
Responded "Yes" for Questions 7-8.

Statement to parents:

Based on your responses, your child is…

…eligible for the study.

…not eligible to participate in the study because (list the Questions for which they responded "Yes" (1-6, 9).

Pediatric Movement and Physical Activity Lab
School of Kinesiology - Auburn University

MOVEMENT. HEALTH. PERFORMANCE.

Physical Activity Readiness Questionnaire (PAR-Q) – Child

Being more active is very safe for most people, and for most should not pose any problem or hazard. However, some people should check with their doctor before they start becoming much more physically active. The following list of questions should be completed by anyone who is looking to start an exercise program, to increase their current activity level, or partake in a fitness testing assessment. The questionnaire helps to determine how safe it is for you.

Common sense is your best guide in answering these questions. Read the questions carefully and answer each one honestly.

Yes	No	
☐	☐	Has your doctor ever said that your child has a heart condition and that your child should only do physical activity recommended by a doctor?
☐	☐	Does your child ever experience chest pains during physical activity?
☐	☐	Does your child lose your balance because of dizziness or has he/she ever lost consciousness?
☐	☐	Does your child have a bone or joint problem that could be made worse by a change in your physical activity?
☐	☐	Does your child have uncontrolled asthma (i.e., asthma that is not easily controlled by an inhaler)?
☐	☐	Is your doctor currently prescribing drugs for your child's blood pressure or heart condition?
☐	☐	Do you know of any other reason why your child should not do physical activity?

If you answered YES

If you answered "yes" to one or more questions, talk with your doctor before your child starts becoming much more active or before your child has a fitness test. Tell you doctor about the PAR-Q and which questions you answered "yes" for your child.

If you answered NO

If you answered "no" honestly to all of the questions, you can be reasonably sure that your child can start becoming much more physically active or take part in a physical fitness appraisal – your child should begin slowly and build up gradually. This is the safest and easiest way to go.

Things Change

Even if you answered "no" to all questions, your child should delay becoming more active if your child becomes temporarily ill with a cold or a fever. If your child's health changes so that you must answer "yes" to any of the above questions, tell your fitness or health professional and ask whether your child should change his/her physical activity plan.

References

This simple screening questionnaire was first developed by The Canadian Society for Exercise Physiology (see references below). The questionnaire is also recommended by the American College of Sports Medicine as a minimum test of readiness for moderate physical activity programs.

- **PAR-Q and You.** *Canadian Society for Exercise Physiology*. Revised 1994.
- **Physical Activity Readiness Questionnaire**, *British Columbia Ministry of Health Department of National Health and Welfare, Canada*, revised 1992.

APPENDIX D: Brockport Fitness Test

Chapter 5

Test Administration and Test Items

This chapter presents test items in the BPFT in detail, along with specific recommendations for administering most test items. Although the BPFT includes 27 test items, testers generally administer only 4 to 6 items to a particular individual. The following list provides general recommendations for administering the BPFT.

- Practice administering test items and be confident of your mastery in administering them before taking formal measurements.
- Develop forms for selecting test items and recording scores, or use materials developed as part of the Brockport Physical Fitness Test.
- Describe the test to participants and explain what it is intended to assess.
- Ensure that individuals being tested dress appropriately; exercise clothing and sneakers (where appropriate) are recommended.
- Plan and provide general and specific warm-ups, as appropriate. This is particularly important for test items involving flexibility or range of motion and strenuous effort.
- Provide cool-down activities after testing. This is especially important after aerobic-functioning test items.
- Provide a positive testing atmosphere. Encourage individuals being tested to try their best and continually provide positive reinforcement for effort.
- Compare participants' performances with criterion-referenced standards rather than with other individuals' performances.
- Administer no more than half of the items on a particular day. If fatigue appears to be influencing performance, provide longer rest intervals between test items.
- Administer aerobic-functioning tests last.
- Administer running items on a surface that is flat and hard yet resilient.
- Give participants who are blind the opportunity to become clearly oriented to a test

The Brockport Physical Fitness Test (BPFT) for youngsters with disability was designed to correspond as closely as possible to health-related, criterion-referenced tests for youngsters without disability. The BPFT corresponds most closely to Fitnessgram (Cooper Institute, 2013). To enhance consistency, the procedures for the following test items, which are also included in Fitnessgram, were adapted, by permission, from The Cooper Institute, 2013, *Fitnessgram/Activitygram test administration manual*, updated 4th ed. (Champaign, IL: Human Kinetics): PACER, one-mile run/walk, percent body fat, skinfolds, body mass index, curl-up, flexed-arm hang, pull-up, modified pull-up, push-up, shoulder stretch, trunk lift, back-saver sit-and-reach, and aerobic-capacity test items. The procedures for other test items were developed by Project Target and the authors of this book.

Scoring and Trials

Three trials are administered using the participant's preferred (stronger) hand. Allow at least 30 seconds between trials. After each trial, the needle should be reset to zero. The tester records each participant's score to the nearest kilogram. The middle score of the three trials serves as the criterion score.

Test Modifications

The dominant grip strength test item should not be administered to individuals without sufficient functional strength or to those unable to grasp or release because of an impairment. Participants can be seated in a wheelchair or on another support surface as long as the test can be administered appropriately.

Suggestions for Test Administration

- All participants must be motivated to enhance maximal effort.
- Do not test subjects until they have learned to perform the test properly.
- Individuals with intellectual disability must be given an opportunity to practice using the equipment and be taught the concept of squeezing with as much force as possible.

Isometric Push-Up

This test item and its procedures were modified from Johnson and Lavay (1989). The participant attempts to hold a raised push-up position for as long as 40 seconds. The test is designed primarily to measure upper-body strength and endurance. The participant assumes a front-leaning rest position with the hands directly below the shoulders, the arms extended, the whole body in a straight line, and the toes touching the floor or mat; this is the correct up position for a push-up (figure 5.14). The test is terminated when any movement—such as bending, sagging, or swaying—occurs at the elbows, shoulders, trunk, or knees. In other words, scoring is terminated when the correct up position for the push-up is no longer held.

Figure 5.14 Isometric push-up.

Modified Curl-Up

The modified curl-up uses the procedure recommended for the curl-up with the following exceptions:

- The hands are placed on the front of the thighs rather than on the mat alongside the body.
- As the participant curls up, the hands slide along the thighs until the fingertips contact the patellae (figure 5.8*a*). The hands should slide approximately 4 inches (10 centimeters) to the patellae or, if necessary, beyond.
- If necessary, testers can place their hands on the individual's kneecaps to provide a more tangible target for the individual's reach (figure 5.8*b*).

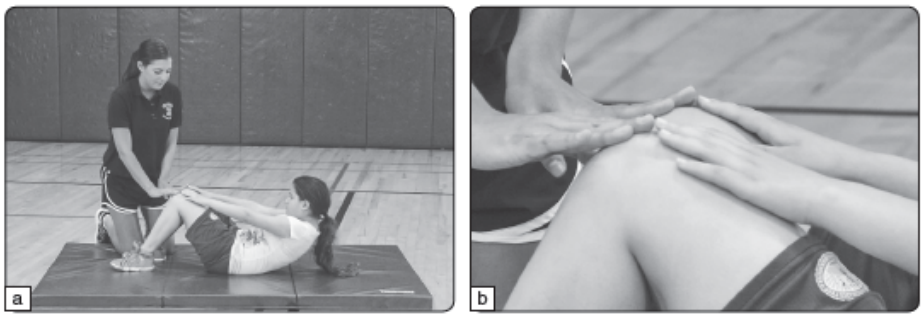


Figure 5.8 Modified curl-up: *(a)* hands sliding to the patellae; *(b)* setting a target.

Trunk Lift

In this test item, the participant attempts to lift the upper body as far as 12 inches (30 centimeters) off the floor using muscles of the back and to hold the position to allow for measurement. The test is designed to measure trunk extension, strength, and flexibility. The participant lies on a mat in a prone position (facedown). The toes are pointed, and the hands are placed under the thighs. A coin or other marker may be placed on the mat in line with the participant's eyes. The participant lifts the upper body off the floor to a maximum height of 12 inches (30 centimeters); see figure 5.22. The movement should be performed in a very slow and controlled manner, and the participant should continue to look at the coin or marker throughout the test to enhance correct alignment of the head. The position is held long enough to allow the tester to measure the distance from the participant's chin to the floor. For safety, the ruler should be placed on the floor at least 1 inch (2.5 centimeters) in front of the participant's chin—not directly under the chin. After the tester makes the measurement, the participant returns to the starting position in a controlled manner.

Figure 5.22 Trunk lift.

Equipment

This test requires gym mats and a measuring stick.

Scoring and Trials

Allow two trials and record the better score to the nearest inch or centimeter. Stretches beyond 12 inches (30 centimeters) are discouraged; therefore, scores beyond that distance should be recorded as 12 inches (30 centimeters).

Test Modifications

For persons with intellectual disability, it is permissible to hold the legs in place on the mat during the test. Individuals with disability should be given sufficient time to practice the test and become thoroughly familiar with the testing procedure. When explaining the test item to participants who are blind, it may be helpful to have them feel an individual demonstrating the skill. If the participant cannot see the coin or marker, he or she should be taught to hold the head at a similar angle.

Suggestions for Test Administration

- Do not allow participants to do ballistic (bouncing) movements.
- Do not encourage participants to rise higher than 12 inches (30 centimeters). Excessive arching of the back can cause compression of the disks.
- Because motivation is an important factor, give positive reinforcement continually throughout the test.
- Pay particular attention to performance technique during this test.

Dominant Grip Strength

In this test, participants squeeze a grip dynamometer with the stronger hand to generate as much force as possible. The test is designed to measure hand and arm strength. The participant should be seated on a straight-backed, armless chair with his or her feet flat on the floor. The tester must first adjust the handle of the dynamometer to fit the hand of the participant; when the dynamometer is squeezed, the second phalanx should rest on the adjustable handle. Once the dynamometer has been adjusted to the correct position, the participant should be instructed to squeeze the handle as hard as possible (figure 5.12). The hand grasping the dynamometer should be held away from the body and chair during the test.

Figure 5.12 Dominant grip strength.

Equipment

Testers should use a good-quality grip dynamometer with an adjustable handle (figure 5.13). Data for this test presented in the tables found in chapter 4 were collected using a Jamar grip dynamometer.

Figure 5.13 Grip dynamometer.

Extended-Arm Hang

In this test, the participant hangs from a bar or similar apparatus for as long as possible, up to 40 seconds. The test is designed to measure hand, arm, and shoulder strength and endurance. The participant begins by grasping the bar using an overhand, or pronated, grip (knuckles toward the face; see figure 5.10). The thumbs should be wrapped around the bar. The participant may jump to this position, be lifted to it, or move to it from a chair. The participant must assume a fully extended position with feet clear of the floor throughout the test. Elbows and knees must not be bent. The participant can be steadied so that he or she does not sway.

Figure 5.10 Extended-arm hang.

Equipment

This test item requires an adjustable bar about 1.5 inches (3.8 centimeters) in diameter at a height enabling performance without touching the support surface. The surface should be no more than 2 feet (0.6 meter) below the feet while the participant is in the hanging position. A gym mat should be placed under the bar. A stopwatch is required.

Scoring and Trials

One trial is permitted for each participant. The score is the elapsed time in seconds (to the nearest second) from the start of a free hang to the time that the fingers leave the bar.

Test Modifications

Individuals with disability must be provided with an opportunity to learn and experience the test item before scores are recorded for testing purposes.

Suggestions for Test Administration

- Be sure that the bar and the participant's hands are dry.
- Constant encouragement is extremely important throughout this test.
- For youngsters who are afraid of falling, keep them as close to the floor or ground as possible. Gently steady them, and assure them that they will be assisted if they lose their grip.

Suggestions for Test Administration

- Testers can place their fingertips along the superior medial angle of the scapula (or on the top of the head) to provide a target for the participant and a more objective criterion for scoring (i.e., if the participant can touch the tester's fingertips, a passing score is awarded).
- Participants should be given ample opportunity to practice this test. Physical assistance may be provided during practice but not during the test.
- Participants should be given encouragement and positive reinforcement.
- Testers must require youngsters to hold the test position briefly (1 to 2 seconds) to award a score of 3. Ballistic or reflexive touches are not acceptable.
- Testing should be preceded by sufficient warm-up, including shoulder-stretching activities.

Back-Saver Sit-and-Reach

The objective of this test is to reach across a sit-and-reach box while keeping one leg straight. The test item is designed to measure flexibility of the hamstring muscles. The participant begins the test by removing his or her shoes (very thin footwear is permitted) and sitting down at the test apparatus. One leg is fully extended with the foot flat against the end of the testing instrument. The other knee is bent, with the sole of this foot flat on the floor 2 to 3 inches (5 to 8 centimeters) to the side of the straight knee. The arms are extended forward over the measuring scale with the hands palms down, one on top of the other. The participant reaches directly forward with both hands along the scale four times and holds the position of the fourth reach for at least 1 second (figure 5.25). After that side is measured, the participant switches the position of the legs and reaches again. The participant can allow the bent knee to move to the side if necessary as the body moves by it.

Figure 5.25 Back-saver sit-and-reach.

Equipment

This measurement is best taken using a flexibility testing apparatus approximately 12 inches (30 centimeters) high and 12 inches wide. A measuring scale is placed on top of the apparatus with the zero end of the ruler nearest the participant and the 9-inch (23-centimeter) mark even with the vertical surface against which the foot rests (see appendix B and figures 5.25 and 5.26). The grid on the box should range from 0 to at least 16 inches (41 centimeters).

Figure 5.26 Commercially built Flex-Tester.

Scoring and Trials

One trial (four stretches, holding the last) is given for each leg. The tester records, to the nearest whole unit, the number of inches or centimeters reached in the last attempt on each side. Reaches beyond the criterion-referenced standards designated for this test item are not recommended.

Test Modifications

Subjects with intellectual disability should be given sufficient practice time to become completely familiar with the testing procedure. They should not be encouraged to exceed the recommended criterion-referenced standards for this test item.

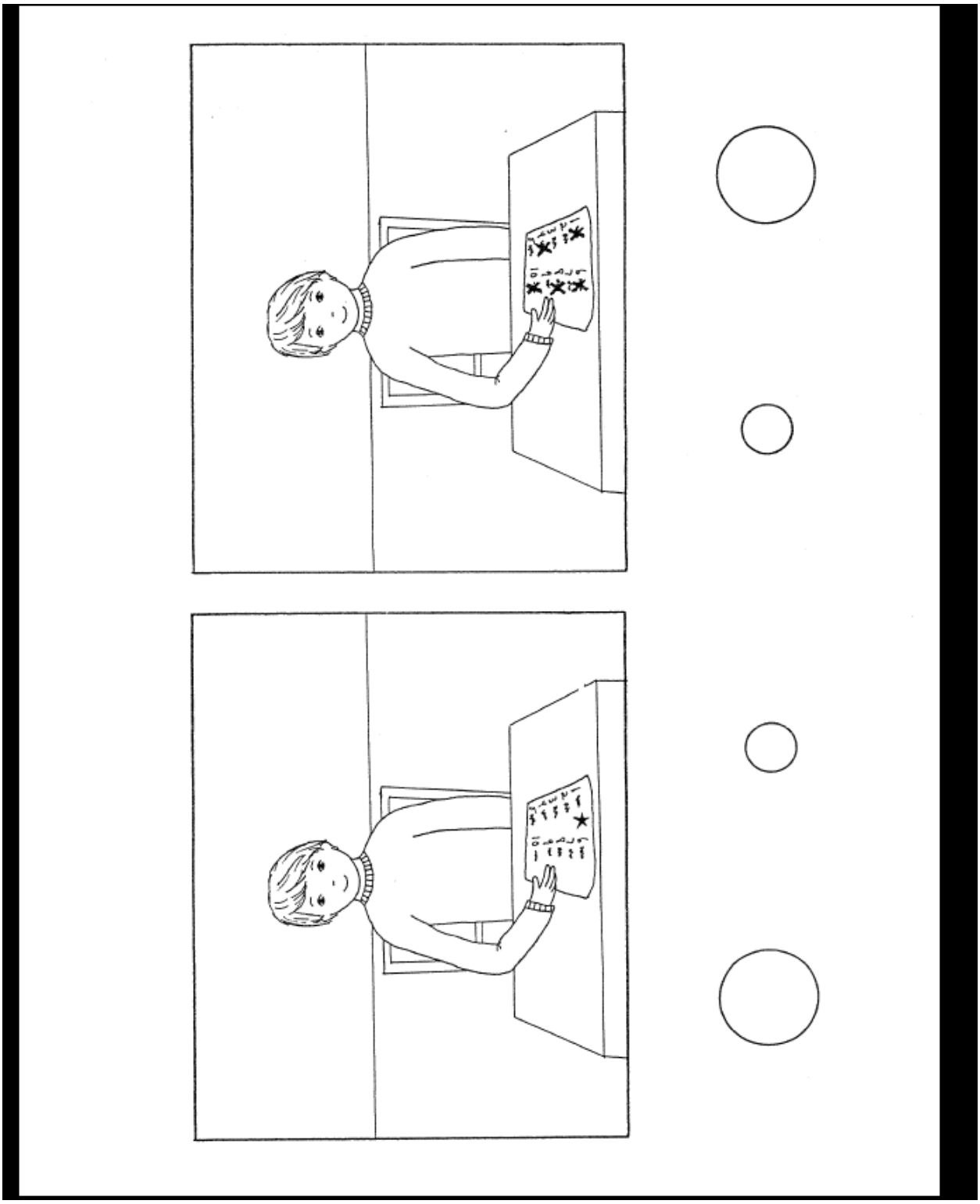
For blind participants, provide verbal description of the testing environment and procedure. These participants may be given physical assistance as they practice the test and become familiar with the procedure. However, physical assistance may not be given during the test itself.

If a flexibility-testing apparatus is not available, measurements can be obtained with a ruler extended over a bench turned on its side. This approach may be less accurate than use of the recommended testing apparatus.

Suggestions for Test Administration

- The knee of the extended leg must remain straight. The tester should place one hand on the straightened leg to assist proper positioning.
- The participant's hands should reach forward evenly, and the shoulders should be square to the test apparatus.
- Hips must remain square to the box. Do not allow participants to turn their hips away from the box as they reach.
- Require participants to stretch the hamstrings and lower back as a warm-up before testing.
- Because motivation is an important factor, participants should receive continual encouragement and positive reinforcement during the testing process.
- Emphasize a gradual reach forward. Do not permit bobbing or jerking movements forward.

APPENDIX E: Harter's Scale of Perceived Competence and Self-Perception Questionnaire



ITEM 1

This boy isn't very good at numbers.
Are you:

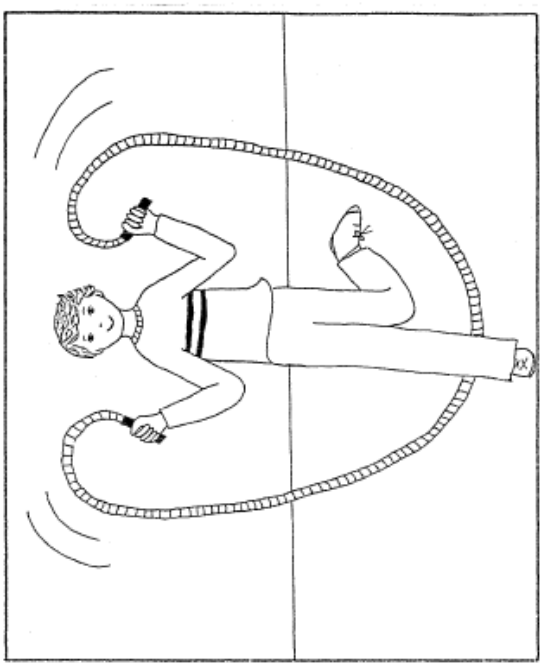
Not too good at numbers OR Sort of good

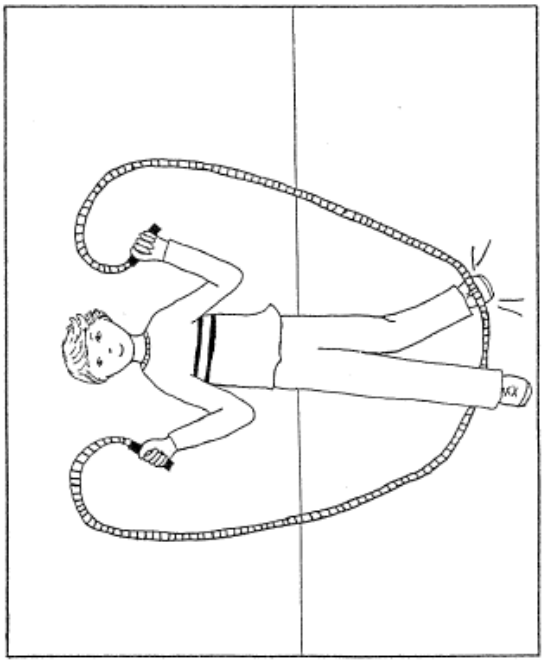
1 2

This boy is pretty good at numbers.
Are you:

Pretty good OR Really good at numbers

3 4

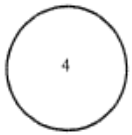




ITEM 23

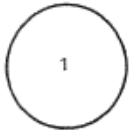
This boy is pretty good at jump rope.
Are you:

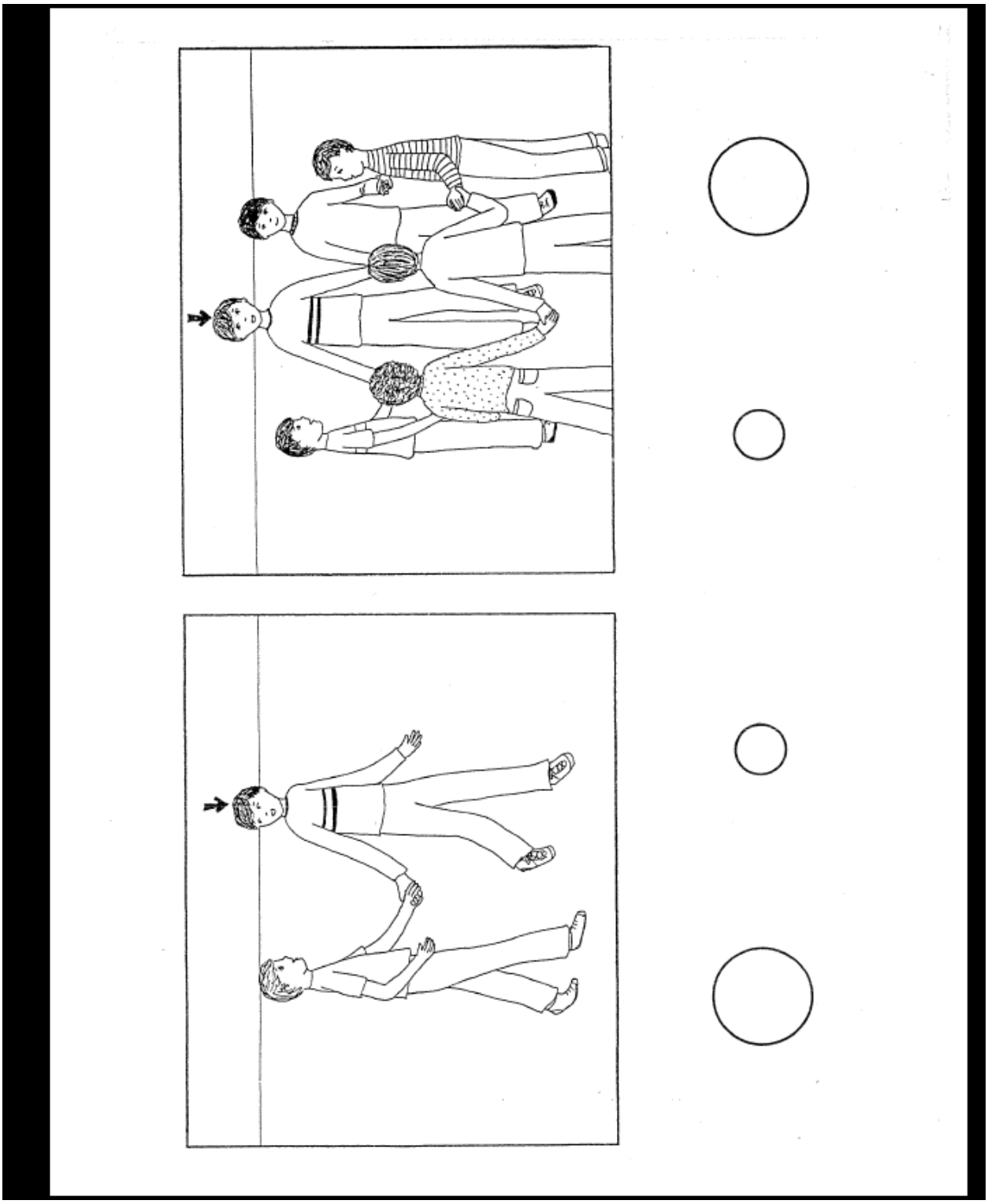
Really good at jump rope OR Pretty good



This boy isn't very good at jump rope.
Are you:

Sort of good OR Not very good at jump rope

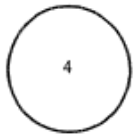




ITEM 2

This boy has lots of friends to play with.
Do you have:

A whole lot of friends to play with



OR

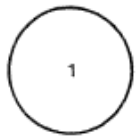
Pretty many

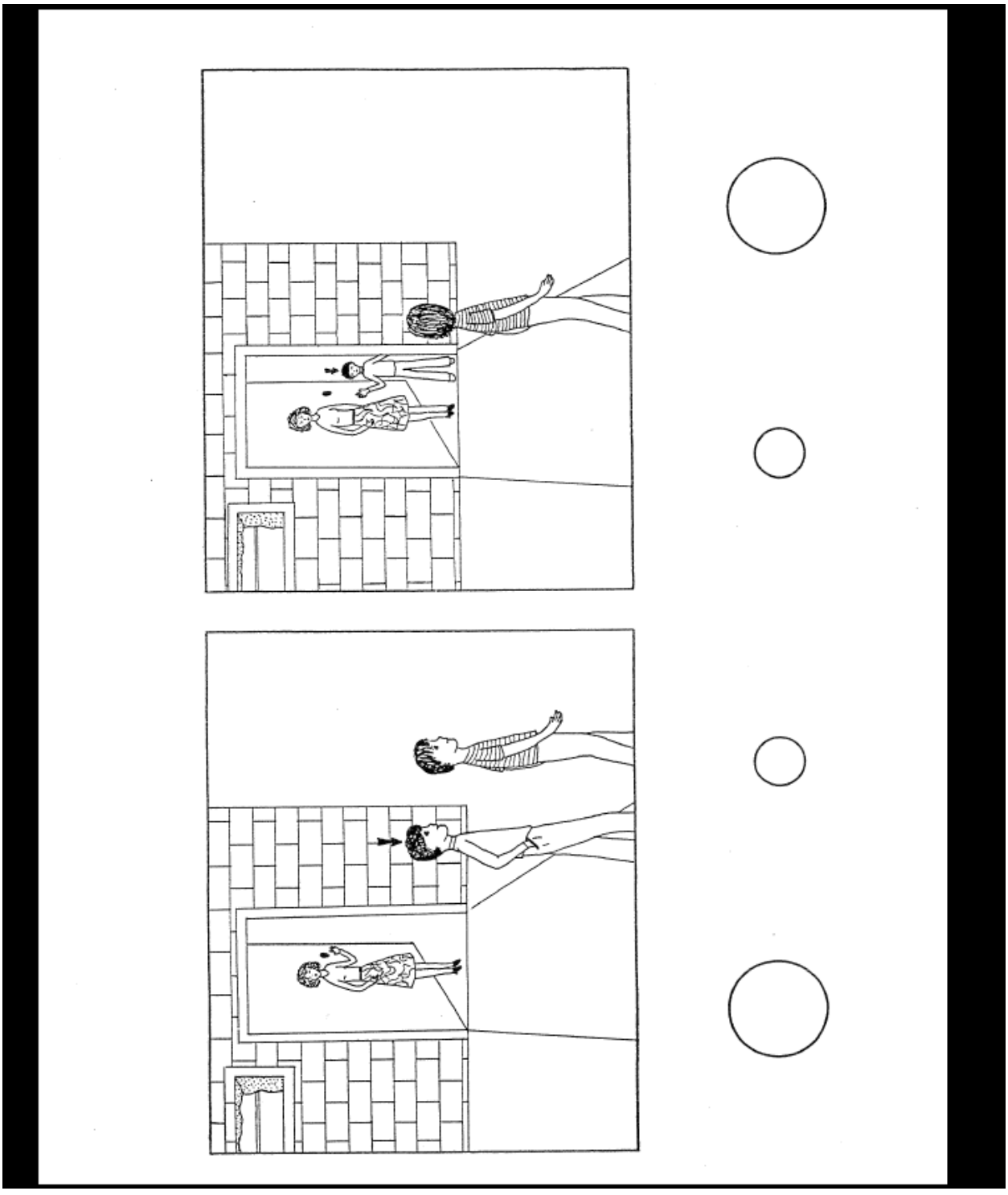
This boy doesn't have very many friends to play with.
Do you have:

A few

OR

Hardly any friends

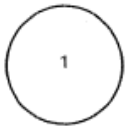




ITEM 4

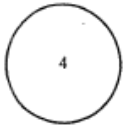
This boy's mom usually doesn't let him eat dinner at friend's houses.
Does your mom:

Hardly every let you eat over OR Sometimes



This boy's mom usually lets him eat dinner at friend's houses.
Does your mom:

Usually OR Always let you eat over



What I Am Like

Name_____ Age____ Birthday _____ ☐ Boy ☐ Girl
Month Day (check one)

	Really True for me	Sort of True for me				Sort of True for me	Really True for me
			Sample Sentence				
a.	☐	☐	Some kids would rather play outdoors in their spare time	**BUT**	Other kids would rather watch T.V.	☐	☐
1.	☐	☐	Some kids feel that they are very good at their school work	**BUT**	Other kids worry about whether they can do the school work assigned to them	☐	☐
2.	☐	☐	Some kids find it hard to make friends	**BUT**	Other kids find it pretty easy to make friends	☐	☐
3.	☐	☐	Some kids do very well at all kinds of sports	**BUT**	Other kids don't feel that they are very good when it comes to sports	☐	☐
4.	☐	☐	Some kids are happy with the way they look	**BUT**	Other kids are *not* happy with the way they look	☐	☐
5.	☐	☐	Some kids often do not like the way they behave	**BUT**	Other kids usually like the way they behave	☐	☐
6.	☐	☐	Some kids are often unhappy with themselves	**BUT**	Other kids are pretty pleased with themselves	☐	☐
7.	☐	☐	Some kids feel like they are just as smart as other kids their age	**BUT**	Other kids aren't so sure and wonder if they are as smart	☐	☐
8.	☐	☐	Some kids know how to make classmates like them	**BUT**	Other kids don't know how to make classmates like them	☐	☐
9.	☐	☐	Some kids wish they could be a lot better at sports	**BUT**	Other kids feel they are good enough at sports	☐	☐
10.	☐	☐	Some kids are happy with their height and weight	**BUT**	Other kids wish their height or weight were different	☐	☐
11.	☐	☐	Some kids usually do the right thing	**BUT**	Other kids often don't do the right thing	☐	☐

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	Really True for me	Sort of True for me				Sort of True for me	Really True for me
12.	☐	☐	Some kids don't like the way they are leading their life	**BUT**	Other kids *do* like the way they are leading their life	☐	☐
13.	☐	☐	Some kids are pretty slow in finishing their school work	**BUT**	Other kids can do their school work quickly	☐	☐
14.	☐	☐	Some kids don't have the social skills to make friends	**BUT**	Other kids do have the social skills to make friends	☐	☐
15.	☐	☐	Some kids think they could do well at just about any new sports activity they haven't tried before	**BUT**	Other kids are afraid they might not do well at sports they haven't ever tried	☐	☐
16.	☐	☐	Some kids wish their body was different	**BUT**	Other kids like their body the way it is	☐	☐
17.	☐	☐	Some kids usually act the way they know they are supposed to	**BUT**	Other kids often don't act the way they are supposed to	☐	☐
18.	☐	☐	Some kids are happy with themselves as a person	**BUT**	Other kids are often not happy with themselves	☐	☐
19.	☐	☐	Some kids often forget what they learn	**BUT**	Other kids can remember things easily	☐	☐
20.	☐	☐	Some kids understand how to get peers to accept them	**BUT**	Other kids don't understand how to get peers to accept them	☐	☐
21.	☐	☐	Some kids feel that they are better than others their age at sports	**BUT**	Other kids don't feel they can play as well	☐	☐
22.	☐	☐	Some kids wish their physical appearance (how they look) was different	**BUT**	Other kids like their physical appearance the way it is	☐	☐
23.	☐	☐	Some kids usually get in trouble because of things they do	**BUT**	Other kids usually don't do things that get them in trouble	☐	☐
24.	☐	☐	Some kids like the kind of person they are	**BUT**	Other kids often wish they were someone else	☐	☐

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	Really True for me	Sort of True for me				Sort of True for me	Really True for me
25.	☐	☐	Some kids do very well at their classwork	BUT	Other kids don't do very well at their classwork	☐	☐
26.	☐	☐	Some kids wish they knew how to make more friends	BUT	Other kids know how to make as many friends as they want	☐	☐
27.	☐	☐	In games and sports some kids usually watch instead of play	BUT	Other kids usually play rather than just watch	☐	☐
28.	☐	☐	Some kids wish something about their face or hair looked different	BUT	Other kids like their face and hair the way they are	☐	☐
29.	☐	☐	Some kids do things they know they shouldn't do	BUT	Other kids hardly ever do things they know they shouldn't do	☐	☐
30.	☐	☐	Some kids are very happy being the way they are	BUT	Other kids wish they were different	☐	☐
31.	☐	☐	Some kids have trouble figuring out the answers in school	BUT	Other kids almost always can figure out the answers	☐	☐
32.	☐	☐	Some kids know how to become popular	BUT	Other kids do not know how to become popular	☐	☐
33.	☐	☐	Some kids don't do well at new outdoor games	BUT	Other kids are good at new games right away	☐	☐
34.	☐	☐	Some kids think that they are good looking	BUT	Other kids think that they are not very good looking	☐	☐
35.	☐	☐	Some kids behave themselves very well	BUT	Other kids often find it hard to behave themselves	☐	☐
36.	☐	☐	Some kids are not very happy with the way they do a lot of things	BUT	Other kids think the way they do things is fine	☐	☐

APPENDIX F: NIH Toolbox