THE IMPACT OF AN EXERCISE INTERVENTION ON STEREOTYPICAL BEHAVIORS IN A CHILD WITH AUTISM SPECTRUM DISORDER

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ABSTRACT

THE IMPACT OF AN EXERCISE INTERVENTION ON STEREOTYPICAL BEHAVIORS IN A CHILD WITH AUTISM SPECTRUM DISORDER

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The purpose of this study is to investigate the impact of an exercise intervention in reducing stereotypical behaviors in a child with autism spectrum disorder (ASD). A single subject A-B-A-B design with a repeating baseline was used for this investigation. The research design will be implemented to determine if an exercise program (i.e., cycling) impact the frequency of stereotypical behaviors demonstrated by a child with ASD. Results indicate that an exercise intervention has the potential to decrease stereotypical behaviors in a child with ASD. While stereotypical behaviors have always been shown to decrease immediately after physical exercise-based interventions (Kern et al., 1984; Powers et al., 1992; Reid et al., 1988), these behaviors seemed to gradually increase and return to baseline levels over a 40 min (Celiberti et al., 1997) to 90 min (Levinson & Reid, 1993) period of rest. Therefore, it is imperative that exercise interventions such as cycling be considered as an APE programming option so that more children with ASD are afforded the social and physiological health benefits provided by cycling. Interobserver agreement was not met in this study.

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CHAPTER I

INTRODUCTION

The American Psychological Association (APA, 2017) defines autism spectrum disorder (ASD) as a group of developmental disabilities causing persistent difficulties in social skills (e.g., making friends), verbal and nonverbal communication (e.g., responding appropriately), and restricted repetitive behaviors. Repetitive and stereotypical behaviors generally refer to a broad range of behaviors including stereotypies (e.g., spinning, jumping), rituals (e.g., hand flapping), compulsions (e.g., hand and finger mannerisms), obsessions, perseveration, and repetitive or stereotypical use of language (Barber, Morgan, Watt, & Wetherby, 2008). In addition to the characteristics, children with ASD experience delays in motor development (Barton, Dumont-Mathieu, Fein, Green, Hodgson, Kleinman, Pandey, Robins, Ventola & Verbalis 2008; Butler & Ghaziuddin, 1998; Dawson, McPartland & Ozonoff, 2002; Manjoiviona & Prior, 1995). These motor delays directly impact exercise levels as lower exercise levels have been reported when compared to their typically developing peers (Anderson, Bandini, Cermak, Curtin, Gleason, Lividini, Maslin & Must, 2013; Pan & Frey, 2006). Researchers have also suggested that health problems related to sedentary lifestyle including cardiovascular disease and obesity are more common in children with ASD (Bandini et al., 2013).

Autism Spectrum Disorder

ASD is a complex neurodevelopmental disorder that occurs in approximately 1 in 68 children (Center for Disease Control and Prevention [CDC], 2014) and results in significant challenges with social skills, communication, repetitive patterns of behavior, interests or

activities (APA, 2013). A diagnosis of ASD can be given between 18 to 24 months (Johnson & Meyers, 2007) and is three to four times more common in boys than girls (CDC, 2014). As ASD is associated with diagnosis, there are different severity levels based on social communication impairments and restricted repetitive patterns of behavior. These severity levels have been categorized into three levels. For example, a Level 1 diagnosis is given when a child requires support and displays deficits in social communication, resulting in noticeable impairments, difficulty initiating social interactions, and may appear to have decreased interest in social interactions. A Level 2 diagnosis is given when a child requires substantial support and displays noticeable deficits in verbal and nonverbal social communication skills, as well as, limited initiation of social interactions with supports in place. A Level 3 diagnosis is given when a child requires very substantial support and exhibits severe deficits in verbal and nonverbal social communication skills causing severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others.

Stereotypical Behaviors in Children with ASD

Children with ASD typically exhibit several stereotypical behaviors or interests including compulsions, echolalia and motor stereotypies, such as hand flapping and body rocking (Bodfish, Lewis, Parker & Symons, 2000), as well as, harmful behaviors, such as aggression and non-compliance (Dunlap, Fox, Vaughn & Wyatte, 2002; Adkins, Lancioni, McAleavey, Singh & Winton, 2006). In addition to these core diagnostic impairments, children with ASD may have a range of impairments in the cognitive and behavioral domains which may include attention problems, intellectual delays, anxiety, depression, aggression, temper tantrums, and self-

injurious behaviors (Bhat, Pescatello, & Srinivasan, 2014; Goldstein, Minshew, & Williams, 2006; Lecavalier, 2006).

Many children with ASD are attentive to routines and oftentimes have difficulty adjusting to unfamiliar surroundings or changes in routine (APA, 2016). The occurrence of stereotypical behaviors is not limited to children with ASD (Abedi, Bahrami, Mohammad-Marandi, & Movahedi, 2012) however, researchers have reported that the incidence and severity of repetitive and stereotypical behaviors tends to be greater, more profound, and more devastating among children with ASD (Bodfish, Lewis, Parker, & Symons, 2000; Smith & Van Houten, 1996). For these reasons, individuals working with ASD need to understand how to implement effective interventions that have demonstrated efficacy in reducing stereotypical behaviors for this population.

Benefits of Exercise

Recently researchers have reported that, children with ASD can gain substantial health benefits from exercise (Dawson & Rosanoff, 2009). Exercise has been defined as a subset of physical activity that is planned, structured, and repetitive and has a final or an intermediate objective in improving or maintaining physical fitness (Caspersen, Christensen, Patel, & Powell, 2017). Physical fitness is a set of attributes that are either health or skill related (Caspersen et al., 2017). Researchers have indicated that children with ASD have improved basic exercise levels when family members were integrated into the physical fitness opportunities (Fragala-Pinkham, Haley & O'Neil, 2011; Pan, 2011). These improved bouts of exercise have correlated with reduced aggression, hyperactivity and stereotypical behaviors in children with ASD and it has

been universally accepted among specialists that exercise is a key component when working with this population (Dawson, McPartland, & Ozonoff, 2002).

The National Professional Development Center on ASD (NPDC, 2015) recognized exercise as an evidence-based practice (EBP) for children with ASD. In their report the NPDC purported that exercise improved physical fitness levels, increased desired behaviors, and decrease inappropriate behaviors for children with ASD, aged 3-5 years (Bobo, Celiberti, Handleman, Harris & Kelly 1997; George, Oriel, Peckus & Semon, 2011; Adams, Bittner, Dillon, Goudy & McNamara, 2017); and adolescents aged 12 to 14 years of age (Dillon et al., 2017; Pan, 2011; Fragala-Pinkham, Haley & O'Neill, 2011). For these reasons, the purpose of this investigation is to determine if an evidence-based practice (i.e., exercise) will reduce the frequency or number of stereotypical behaviors demonstrated by a child with ASD.

Exercise as an Intervention

Exercise typically involves instructing and providing opportunities for children to engage in some form of exercise (American College of Sports and Medicine [ACSM], 2008). Several exercise modalities, include swimming, jogging, cycling, weight training, walking, and horseback riding have been used as interventions for children with ASD (Ashbaugh, Lang, & Koegal, 2010; Meulenbroek & Sowa, 2012). For example, Bachman and Fuqua (1983) evaluated the effects of jogging in four children with developmental disabilities who exhibited problem behaviors, including off-task behavior, inappropriate vocalizations, motor delays, or some combination. Results from this study indicated a decrease in inappropriate behaviors for three of four participants and an inverse relationship between the level of exercise and the amount of inappropriate behavior for three of the four participants. Furthermore, a meta-analysis of 16

studies suggested that, on average, exercise interventions led to a 37% improvement in overall symptomatology of ASD, specifically behavioral and academic improvements (Meulenbroek & Sowa, 2012).

The effectiveness of physical exercise implemented as an intervention has demonstrated a wide variety of benefits for children with ASD (Abedi, Bahrami, Marandi, & Movahedi, 2012). These benefits include significant improvements in physical fitness (Fragala-Pinkham, Haley & O'Neil, 2008; Crews & Lochbaum, 2003), academic skills (Bray, Heest, Kehle, & Nicholson, 2011; George, Oriel, Peckus, & Semon, 2011), sensory skills (Bass, Duchowny & Llabre, 2009; Haung, Su, Wang, & Wuang, 2010), inappropriate vocalizations (Best & Jones, 1974), social skills (Bass et al., 2009), stress and quality of life (Dattilo & Garcia-Villamisar, 2010), out-of-seat-behaviors (Gordon, Handleman, & Harris, 1986), on-task behavior (Kern et al., 1982), off-task behavior 9Factor, Freeman, Reid & Sherman, 1988), aggression levels (Allison, Basile, & MacDonald, 1991), and self-injurious behavior (Dobbin, Elliott, Rose, & Soper, 1994). These results demonstrate the effectiveness and importance of increasing the exercise levels of children with ASD.

Exercise levels in children with ASD

More than 80% of adults with ASD do not meet the guidelines for both aerobic and muscle-strengthening activities (US Department of Health and Human Services, 2012). This lack of exercise has also been reported for children with ASD as more than 80% of this population do not meet the physical activity guidelines (HHS, 2012). Pan and Frey (2006) reported that youth with ASD were less active than their typically developing peers (Bauman, Brown, Owen, Sallis & Trost, 2002). These reports have been strengthened as researchers have

gone on to report children with ASD are 40% more likely to be overweight and obese compared to their typically developing peers (Anderson, Bandini, Curtin & Must, 2010). In addition, physical activity levels have been reported to decline with age and some youth with ASD do not accumulate the recommended daily 60 minutes of moderate-to-vigorous physical activity (MVPA).

Physical activity levels in children with ASD are significantly lower compared when compared to their typically developing peers (Borremans, McCubbin, & Rintala, 2010; Esposito, Macdonald, & Ulrich, 2011). Participation in physical activity is often a challenge for individuals with ASD because of poor motor functioning and low motivation (Koegel, Koegel, & McNerney, 2001; Lloyd, O'Connor, & Reid, 2003), as well as, difficulty in planning and generalization of skills (Filloux, McMahon, Ozonoff, & Strayer, 1994; Renner & Klinger, 2000). Limited physical activity levels or physical exercise for children with ASD may be attributed to impairments in motor, social communication, sensory, and behavioral domains (Bhat, Pescatello, & Srinivasan, 2014).

Exercise impacts on behaviors of children with ASD

Researchers have reported improvements in attention span, social behavior, and learning in children with ASD following aerobic exercise (Bobo, Celiberti, Handleman, Harris & Kelly, 1997; Oriel, George, Peckus, & Semon, 2011). Intensity, duration and type of exercise needed to reduce stereotypical behaviors has been a common theme in past research. Exercise (i.e., jogging) when implemented as an intervention has demonstrated a decrease in maladaptive behaviors for approximately 40 minutes following the exercise, and further research with exercise interventions supports the claim that exercise decreases disruptive behaviors in the short

term for youth with ASD (Bobo et al., 1997; Mitchell & Rosenthal-Malek, 1997; George, Oriel, Peckus, & Semon, 2011; Adamson, Block, Einarson, Harris, Petrus & Sharifnejad, 2008). In addition, improvements have been reported in exercise programs using swimming, therapeutic horseback riding, and cycling (Bass, Duchowny, & Llabre, 2009; Lang et al., 2010, & Pan, 2010).

Physical exercise has been reported to improve the physical conditioning and reduce the maladaptive behavioral patterns of children with ASD (Lancioni & O'Reilly, 1998). Further, aerobic exercise has been reported to reduce stereotypical behavioral patterns of children with ASD (Dobbin, Elliott, Rose, & Soper, 1994; Birkan, Bumin, Yanardag & Yilmaz, 2004) and self-stimulating behaviors (Powers, Rose & Thibodeau, 1992). These results are important as Pan (2008) concluded that, overall, children with ASD engage in less activity when compared to their typically developing peers. Additionally, Chorus, Hildebrandt and Stubbe (2010) stated that children with ASD constitute a special risk due to the populations sedentary lifestyle and given that this lifestyle increases the risks of heart disease, diabetes, and obesity (World Health Organization, 2002). It is the researcher's belief that physical exercise when used as an intervention can be has proven to be an effective means to prevent these problems for individuals with ASD and provide future benefits to this population. These benefits include: (a) improved cardiovascular endurance (Dawson & Rosanoff, 2009); (b) intellectual functioning, (c) perception, (d) behavior, (e) affect, and (f) personality (Lang et. al., 2010).

Motivation

Children with ASD typically display low levels of engagement (Keen, 2009) and often lack motivation to engage in exercise (Butler-Kisber, Reid & Todd, 2010). Research has shown

that children's participation is motivated mainly by competence (the desire to engage challenges and exercise and expand skills) and enjoyment (desire to have fun and pursue interests) as primarily having an intrinsic motivation (Fredrick, Lepes, Rubio, Ryan & Sheldon, 1997). By contrast, extrinsic motivation is evident when children are engaging in activities for obtaining rewards, avoiding negative consequences or achieving competence (Chu, Hsieh, Pan & Tsai, 2011). Some examples of extrinsic rewards are primary objects, token systems, social approval, and project activities (Mercer & Witzel, 2003).

Research has shown activities that work well to influence stereotypical behaviors include rhythmic activities that involve large muscle groups and are continuous (e.g., running, cycling, or swimming) [Crollick, Mancil & Stopka, 2006]. Researchers should observe the child's stereotypical behavior and design exercises that reflect the child's interests as well as strengths, age, social and cognitive demands, and attitude toward competition and cooperation (Reid & O'Connor, 2003). Research suggests that individuals with ASD that have higher perceptions of competence tend to spend more time engaged in positive behavior and less time engaged in negative behavioral outcomes (Dunn & Dunn, 2006).

Framework: Evidence-Based Practice

In 2015 the NPDC recognized exercise as an EBP. EBPs are instructional techniques that have demonstrated their efficacy and represent critical tools in bridging the research-to-practice gap and improving student outcomes (Cook, Smith & Tankersley, 2011; Slavin, 2002). Exercise as an EBP has been proven to be effective for preschool aged (i.e., 3-5 years) and middle school aged children (i.e., 12-14 years) with ASD. The NPDC (2015) report detailed how exercise can be used effectively to address; motor, behavior, school readiness, and academic outcomes.

Further, researchers have reported that aerobic exercise physiologically modulates stereotypical behaviors for children with ASD through the release of specific neurotransmitters (Baranek, 2002). These reports have generated interest in the application of physical exercise as an intervention for specific stereotypical behaviors of children with ASD (Petrus et al., 2008). To facilitate EBPs, Lang et al., (2010) provided a systematic review of interventions designed to increase the exercise behavior of children with ASD. Exercise behaviors used in most of the studies consisted of run or jogging, water-based exercises, stationary bike riding, lifting weights, treadmill walking, roller-skating, muscle toning with stretching, and walking in snowshoes (Lang et al., 2010). All the reviewed studies reported improvements in either behavior (i.e., reduced stereotypy, aggression, or self-injury), academics (i.e., increased amount of time on-task or increased accuracy in academic responding), physical fitness (i.e., increased endurance, strength), or increased exercise behavior (i.e., increased time in exercise). These results suggest that programs for children with ASD may benefit from including components designed to incorporate regular and specific types of physical exercise.

Assumptions

The study is subject to the following assumptions:

1. The Fitbit will function without error.
2. The paraprofessional will complete the daily documentation sheet honestly and truthfully.
3. Exercise will decrease the total number of stereotypical behaviors demonstrated by the participant.

Delimitations

Delimitations of this study include:

1. Study will occur at the same time, in the same setting every day.
2. A valid instrument was used to record heart rate.
3. Only one type of exercise will be used throughout the study.

Limitations

Limitations of this study include:

1. Generalization of results is weakened by a small population size (n = 1).
2. Variability within autism spectrum disorder (ASD)
3. Participants degree of effort during all phases were not measured.
4. Length of study and number of times data was recorded.
5. Methods used to address the purpose of the study.

Purpose Statement

The purpose of this study is to investigate the impact of an exercise intervention in reducing stereotypical behaviors in a child with autism spectrum disorder.

Hypothesis Statement

The researcher hypothesized that an exercise intervention (e.g., cycling) will reduce the frequency of stereotypical behaviors in a child with autism spectrum disorder.

Literature Review

Researchers focusing on effective interventions for children with ASD in the physical education setting have begun to identify interventions with strong empirical evidence of effectiveness (Callahan, Hughes, Kutlu, Mehta, Nichols, Toussaint & Wang, 2016). Specifically, researchers have suggested that increased levels of exercise have decreased inappropriate behaviors (e.g., stereotypical behaviors; Bachman, 1983; Lang, et al., 2010). Despite these reports, there is limited research that focuses on the physical effects of exercise specific to children with ASD (Ashbush, Koegel, Lang & Register, 2010). Lang (2010) has also reported a lack of rigorous methodologies in the current studies. Fort this reason, it is difficult to ascertain what type of exercise (e.g., aerobic, anaerobic) and duration are needed to decrease the stereotypical behaviors demonstrated by this population. Therefore, the purpose of this literature review is to examine relevant literature pertaining to children with ASD and exercise interventions focused on decreasing stereotypical behaviors.

Autism Spectrum Disorder

Characteristics of ASD include impaired social interactions, delayed or limited communication skills, and restrictive patterns of activities or interests (APA, 2013; CDC, 2014; Cobham, Magnusson & McLeod, 2012). Deficits in social skills are communication problems which include difficulty using or understanding language (e.g., verbal, nonverbal). While repetitive body movements or behaviors include hand flapping or repeating sounds or phrases (APA, 2016). These characteristics may cause children with ASD to have difficulty in social situations and therefore, make engaging in regular exercise difficult (Cobham, Magnusson & McLeod, 2012). Lang (2010) provided support for the above reports and further reported that

children with ASD may suffer impairments in motor skills and are likely to engage in little exercise.

Stereotypical Behaviors for Children with ASD

Children with ASD have demonstrated sensory impairments in modulating tactile, auditory, visual, and vestibular inputs, with hyperresponsiveness or hyporesponsiveness to sensory stimuli (Bhat, Pescatello & Srinivasan, 2014; Dunn & Tomchek, 2007). In addition, children with ASD may also have pervasive gross motor impairments, such as poor visuomotor and bilateral coordination, as well as, postural impairments in static and dynamic balance (Bhat, Galloway & Landa, 2011; Bhat, Pescatello, & Srinivasan, 2014; Cauraugh, Fournier, Hass, Lodha & Naik, 2010; Furman, Jones, Minshew & Sung, 2004). Therefore, individuals working with children with ASD will need to understand the myriad of impairments in each of the domains.

Benefits of Exercise

Exercise has been defined by the World Health Organization (WHO, 2017) as planned, structured, repetitive, and aims to improve or maintain one or more components of physical fitness. The WHO (2017) went on to define physical activity as any bodily movement produced by skeletal muscles that require energy expenditure. Physical activity may be structured (e.g., organized sporting events) or unstructured (e.g., use of playground equipment) and may involve commonly recognized physical exercises (e.g., running, lifting weights), as well as, activities, such as doing household chores and gardening (Ayvazoglu, 2009; Biddle, 1994; Miccinello & Obrusnikova, 2012). Lang (2010) reported increased academic behaviors (i.e., on-task behavior, correct responding) and decreased challenging behaviors following various types of exercise

(i.e., jogging, weight training, bike riding). Previous researchers have reported that frequency of exercise at a vigorous level is more beneficial than mild levels exercise for treating stereotypical behaviors in children with ASD (Abedi, Bahrami, Mohammad & Movahedi, 2012; Celiberti, et al., 1997; Elliott et al., 1994; Kern et al., 1984; Levinson & Reid, 1993). These reports have been supported by Prupas and Reid (2001) who reported a reduction in stereotypical behaviors following a daily 10-minute walk/jog bout of exercise.

Exercise as an Intervention

Researchers have documented the benefits of physical exercise and sport participation in typically developing children (Bar-Or & Rowland, 2004) and in children with developmental disabilities, including those with ASD (Bachman & Sutter, 1988; Fong, Ng & Tsang, 2012). Research pertaining to the impact of exercise on children with ASD has been considerable over the past 30 years (Beets, Grover, Pitetti & Rendoff, 2007; Cuccaro, Gabriels, Golson, Hill & Ivers, 2012). These researchers have reported positive effects of exercise interventions in children with ASD and have suggested that regular exercise has beneficial effects in alleviating social, behavioral, cognitive, and motor impairments for children with ASD (Ashbaugh, Koegel & Lang, 2010; Muelenbroek & Sowa, 2012). Most notably, researchers reporting on the impact of physical activity and exercise on children with ASD found positive benefits in motor skills (Pan, 2011; Pitetti et al., 2007), endurance (Pan, 2011; Todd & Reid, 2006; Todd et al., 2011), strength (Crews & Lochbaum, 2003; Pan, 2011), cardiovascular (Pan, 2011) aerobic fitness (Crews & Lochbaum, 2003), and flexibility (Pan, 2011). These past results demonstrate the importance of implementing daily exercise programs for children with ASD.

Exercise levels in children with ASD

The Centers for Disease Control (CDC, 2016) recommends children participate in 60 minutes or more of daily physical activity with a majority being at a moderate-to-vigorous activity (MVPA) at least three days a week. Since physical exercise has proven to be an effective means to prevent heart disease, diabetes and obesity (WHO, 2002) in the general population, one could assume these same results would be seen for children with ASD. For example, Beets, Grover, Pitetti and Rendoff (2007) reported that a walking program not only improved the physical conditioning, but also reduced the body mass index (BMI) of ten children with ASD. Researchers have pointed to the disability itself as the major factor impacting fs physical activity (PA) levels for children with ASD (Pan, 2011). Pan and Frey (2005) reported that children with ASD were less active than their typically developing peers, and a decline in PA with age was also observed. Results of children with ASD having a difficult time with social interaction and communication (Pan, 2011), may result many times in isolated play, or play with low communication or interaction and may lead to children with ASD disengaging themselves from the activity altogether (Schuler & Wolfberg, 1999). Because PA declines rapidly during adolescence (Trost et. al., 2002), further research is needed to determine whether the unique characteristics associated with ASD and environmental factors place children with ASD at a greater risk for inactivity compared to their typically developing peers when provided equal opportunities to be active (Pan, 2011).

Exercise impact on behaviors of children with ASD

Exercise programs have been used as interventions for a variety of developmental and psychiatric disorders (Lambourne, Okumura & Tomporowski, 2003), with overall positive

effects on reducing stereotypical behavior (Petrus et al., 2008). Lang et al. (2010) reported improvements across many domains, including negative behaviors (i.e., stereotypy, aggression, and self-injury), positive behaviors (i.e., on task, academic performance), physical fitness (i.e., endurance, strength), and exercise behavior (i.e., time engaged in exercise). Current literature pertaining to exercise and stereotypical behaviors has relied heavily on utilizing video recordings, standardized data forms, such as behavioral observation (Shapiro, 2013), and teacher reports (Anderson-Hanley, Schneiderman & Truck, 2011). For example, Levinson and Reid (1993) monitored the frequency of stereotypical behaviors during the 45 minutes immediately following treatment (i.e., vigorous exercise) through an interval-sampling procedure in videotaped sessions. Results from this investigation indicated that significant reductions in stereotypical behaviors occurred as a function of vigorous exercise. Researchers have also reported a reduction in stereotypical behavior patterns of children with ASD following aerobic exercise (Dobbin, Elliott, Rose & Soper, 1994; Birkan, Bumin, Yanardag &Yilmaz, 2004) and self-stimulation behaviors (Powers, Rose & Thibadeau, 1992). For these reasons, individuals working with children with ASD should include daily MVPA within their program.

Framework: Evidence-Based Practice

In 2015, The National Professional Development Center (NPDC) on ASD classified 27 focused interventions as evidence-based practices (EBPs). The NPDC created and refined a model to address the learning needs of individual learners (e.g. assessment, implementation and outcomes) as a professional resource including detailed information on how to plan, implement, and monitor specific EBPs. Studies included in the 2014 EBP report detailed how exercise can be used effectively to address: motor, behavior, school readiness, and academic outcomes and

recommended that when developing an exercise plan, the length and frequency of the intervention should incorporate at least one routine per day of at least 10-20 minutes, resulting in moderate to vigorous physical exertion.

It is mandated by federal regulations (Individuals with Disabilities Education Act [IDEIA], 2004; No Child Left Behind [NCLB], 2002) and state and local education policies that service providers use EBPs in public education for children with disabilities, including children with ASD. (Callahan et al., 2017). Research suggests that a variety of factors related to the users of EBPs, the practices themselves, and their institutional context (Cook & Odom, 2013; Asher, Carlson, Coffman, Etzel-Wise, Marty & Rapp, 2010) have been reported to negatively affect the effective use of EBPs. These factors include but are not limited to: lack of knowledge of EBPs, limited availability of training, low competence of service providers, high costs, lack of time for planning and preparation, and difficulties using some interventions, among many other (Callahan et al., 2010). However, research suggests that by identifying socially validated EBPs, could help address some of the barriers to effective implementation of EBPs, and address the pervasive research-to-practice gaps in ASD programming (Dingfelder & Mandell, 2011). More importantly, a prioritized list of validated interventions and training resources could ultimately result in improved outcomes for children with ASD and their families (Callahan et al, 2016).

Key Terms

Autism Spectrum Disorder (ASD): A group of developmental disabilities causing persistent difficulties in social skills (e.g., making friends), verbal and nonverbal communication (e.g., responding appropriately), as well as, restricted repetitive behaviors (APA, 2013).

Body rocking: A monotonous rhythmic movement (i.e., rocking back and forth or side to side), which occurs in various conditions (e.g., autism; Cleveland, 2013).

Hand flapping: Holding hand or fingers up in the air for at least one second.

Exercise: A subset of physical activity that is planned, structured, and repetitive and has a final or an intermediate objective the improvement or maintenance of physical fitness (Caspersen, Christensen, Patel & Powell, 2017).

Self - stimulation: A behavior that consists of repetitive, stereotyped behavior that has no apparent functional effects on the environment, examples of which are rocking, hand-waving, and head-waving (Kaufman & Levitt, 1965; Berkson, 1967), mouthing or rubbing parts of one's body (Berkson & Mason, 1964; Hollis, 1965; Hutt and Hutt, 1965).

Stereotypical behaviors: are behaviors that may be verbal or nonverbal, fine or gross motor-oriented, as well as simple or complex (Cunningham & Schreibman, 2008).

Vocalizations: A delayed, non-contextual repetitive speech or the occurrence of a vocal verbal utterance with point-to-point corresponding to an auditory stimulus that had no direct relation to any object, event, or vocal stimulus in the immediate environment (Cihon, Eshleman & Guzinski, 2012).

CHAPTER II

METHOD

The purpose of this investigation is to examine the effects of a evidence-based practice (EBP; exercise), in reducing inappropriate stereotypic behaviors in a child with ASD). A research design for this investigation will be implemented to determine if an exercise program (i.e., cycling) impacts the frequency of stereotypical behaviors. A single subject withdrawal design (i.e., A-B-A-B) with a repeating baseline will be used for this investigation. Therefore, information in this chapter related to the method is presented in the following sections: (a) Participant Information, (b) Instrumentation data, (c) Procedures, (d) Research Design, (e) Data Analyses.

Participants

One child (i.e., female) 15 years of age, was recruited for this investigation. The participant had been previously diagnosed with ASD (i.e., required substantial support at all times) and currently attended a school in California. The participant was selected based on the following criteria: (a) currently receives adapted physical education services, (b) demonstrates stereotypical behaviors (i.e., body rocking, hand flapping, self-stimulation, inappropriate vocalizations) that impede her ability to function in the general education class, (c) previously demonstrated the ability to ride a tricycle, and (d) demonstrated a willingness to participate in the exercise-based intervention. Additionally, the participant is nonverbal and relies on communication devices.

Based on the participants height (i.e., 5'1") and weight (i.e., 134 lbs.), the Center for Disease Control (CDC) has calculated her body mass index at 24.6 which places her in the 88th percentile (i.e., overweight). The female displays four stereotypical behaviors which include: body rocking, hand flapping, self-stimulation, and inappropriate vocalizations. These behaviors occur throughout the day may be influenced by the lack of regular exercise participant receives i.e., currently riding a tricycle for 5 to 10 minutes twice a week).

Instrumentation

For this investigation the primary researcher will be recording the total time in exercise (i.e., cycling and heart rate levels during that exercise. Total time and heart rate will be recorded using the *Fitbit Heart Rate Monitor (Fitbit Alta)*: The Fitbit is one of the most common wireless physical activity trackers in the consumer market (Chang, Davidson, Diaz, Goldsmith, Krupka, Ma, Peacock & Schwartz, 2015). The *Fitbit*, designed by Gadi Amit (2007), actively monitors and has demonstrated to be a valid and reliable device for measuring step counts in healthy young adults (Bahar, Guenther, Hunt, Napier, Pollock & Takacs et al., 2014). In addition, this device will measure frequency, duration, intensity and pattern of movement to determine steps taken, distance traveled, and calories burned (Ayala, Cadmus-Bertram, Madanat, Natarajan, Nichols, Pierce, Wang & White, 2015).

The participant will be riding a *Rifton Tricycle:* Designed by *Rifton Equipment Company* (2011). The Rifton Tricycle is an adaptive tricycle made for individuals with physical disabilities and has therapeutic value, as well as, recreational values. Researchers have reported that individuals using the *Rifton Tricycle* have improved balance, coordination and strength in individuals with disabilities (Adeyeri & Ayodeji, 2011; Barroso, Burghardt, Lloyd & Ulrich,

2008; Bundonis, 2009). In addition, steering exercises, uphill pedaling, stopping and starting, backing up, and safety awareness, can be incorporated into practice sessions for further challenge.

Daily Documentation Sheet - The daily documentation sheet will be used every day throughout the intervention. Two paraprofessionals will observe the stereotypic behavior and document the behavior in 15-minute increments by placing a tally in the box each time it is observed. The stereotypic behaviors being observed are self-stimulation, body rocking, hand flapping and vocalizations.

Procedures

The participant for this study was recruited from a school in California. The following paragraphs are related to: (a) Recruitment of Participants, (b) Performance Setting, (c) Program Planning, and (d) Assessment.

Recruitment of Participants

Recruitment of the participant began after gaining Institutional Review Board (IRB# 17-105) approved by Humboldt State University on January 17th, 2018. The participant for this investigation was recruited from a school in California and selected based on a previous diagnosis of ASD. The primary researcher was held responsible in obtaining guardian approval (i.e., consent form) and verbal assent from the participant with ASD. The primary researcher verbally explained the procedures for this investigation to school administration and teachers directly involved with the student. The primary researcher will assure the staff, guardians and

participant that this study is voluntary and that to take part, assent and consent forms must be agreed, signed and returned.

Performance Setting

This study will take place in the school gymnasium during the participants regularly scheduled adapted physical education (APE) class in which participant attends 5 days a week, for approximately 50 minutes, during third period. On a normal day all students in this class are directed to the south gym and line up along the wall for attendance. There are 12 students from life skills that are joined by five students from resource (i.e., peer tutors). Shortly after attendance has been taken, all students participate in a warm- up. The unit that will take place and implemented by the adapted physical education teacher, during the intervention is basketball. On Monday and Wednesday the whole class of students participate in a sport or recreational unit (i.e., basketball) for approximately 30 of the 50 minutes. On Tuesday and Thursdays students are directed to the weight room, where they are required to finish two upper body and two lower body workouts in three sets. On Friday's students are granted with a choice of activity.

Program Planning

Due to the participants severity of ASD, lack of interest in athletics, ability to adequately perform in the sport unit (i.e., basketball) and weightlifting alongside her peers; the participant will take part in an exercise intervention (e.g., cycling). The intervention will consist of a 15-minute cycle, inside around the gym, during school, every day, pending illness and absences. The student will complete the intervention alongside her peers, paraprofessionals and primary

researcher. The primary researcher utilized the participant's classroom timer to indicate time-left in the exercise intervention. The primary researcher also used a token economy that gave the participant a choice of activity following the completion of the intervention. The choice or rewards (i.e., extrinsic motivation) that the participant choose from, included: listening to music, sensory ball or playing on the keyboard.

Prior to the start of this study, a trial beginning, January 8th, 2018 will be implemented for one week in preparing the participant, paraprofessionals and researcher with materials and instruments. The study will take place over the course of six weeks. Beginning January 15-19th of 2018; the researcher and paraprofessionals will collect baseline data on the student's daily documentation sheet for one week. After a baseline has been established, the first intervention phase (e.g., exercise) will be implemented for one week beginning January 22nd-26th, 2018. During the exercise intervention, the student will cycle on the *Rifton Tricycle* for 15 minutes at a moderate-to-vigorous level of physical activity. During the one-week intervention, data collection (i.e., *Daily Documentation Form* and the *Fitbit One*) will continue to be recorded daily. During the second baseline phase, the intervention will be withdrawn (January 29th-February 2nd, 2018) for one week to see if stereotypic behaviors return to baseline. Following the baseline phase, the intervention will be reintroduced (February 5th-9th, 2018) for another week, while continuing to collect data. After an additional two weeks, the researcher will do a follow up (February 19th, 2018) obtaining observational data with the *Daily Documentation Form* and implementing the exercise intervention for one day.

Assessment

Data will be collected throughout the study (i.e., baseline, intervention, baseline, intervention) using the participant's *Daily Documentation Form* (i.e., interval-sampling) and the *Fitbit One.* The *Daily Documentation Form* will measure the participant's stereotypic behaviors (i.e., body rocking, hand flapping, self - stimulation and vocalizations) in 15-minute intervals, every day for the duration of this study. The primary researcher will tally the total number of stereotypical behaviors for each 15-minute intervals. The stereotypic behaviors being observed are as follows: (a) body rocking (i.e., a rhythmic movement, back and forth or side to side for at least 1 second), (b) hand flapping (i.e., holding hands, fingers in the air or holding ears for at least 1 second), (c) self - stimulation (i.e., mouthing or rubbing parts of one's body for at least 1 second), and (d) vocalizations (i.e., a delayed, non-contextual repetitive speech that has no direct relation to any object, event, or vocal stimulus in the immediate environment).

The Fitbit will be used to measure duration, intensity, heart rate (i.e., resting, average and peak) (Wang et al., 2015). Heart rate will be measured one minute immediately prior to exercise and one minute immediately following exercise to determine if exercise can help reduce stereotypic behaviors in an adolescent with ASD. All data will be uploaded to the researcher's computer to analyze and document in SPSS.

Research Design

In this investigation, a single-subject withdrawal design (i.e., A-B-A-B; Ramasamy, Richards & Taylor, 2013) will be implemented and involve a recurring baseline to determine if

the independent variable (i.e., exercise) impacted the dependent variable (i.e., total number or percentage or frequency) of stereotypical behaviors demonstrated (Carr, Halle, Horner, McGee, Odom & Wolery, 2005). The A-B-A-B design is particularly important due to the systematic observation and recording of behavior. The effectiveness of single-subject design relies on demonstrating that changes in the dependent (i.e., frequency of behavior) variable are directly attributed to the presence or absence of changes in the independent variable (i.e., exercise). Continuous measurement of the dependent variable and subsequent changes in accordance with the researcher's manipulation of the independent variable allows a direct demonstration within the design. Prediction, verification, and replication of effects are present when this functional relationship exists.

Baseline

Measurement during the baseline phase will occur until the observed pattern of responding is sufficiently consistent to allow prediction of future responding (Wolery et al., 2005). Documentation of a predictable pattern during the baseline phase will include five data points; with a trend in the direction opposite then predicted by the intervention (Horner, et al, 2005).

Intervention One

During the treatment phase, repeated measures are obtained using the same measures in the baseline phase. The patterns and frequency of the data points will be compared to the data

points in the baseline phase to determine whether a change has occurred. It is recommended the length of the treatment phase be as long as the baseline (Barlow & Hersen, 1984; Tripodi, 1994).

Baseline Two

Similar to the first baseline phase, the researcher expects the observed behaviors to return back to baseline. The baseline phase will contain five data points, with a trend in direction opposite then predicted by the intervention (Horner, et al., 2005).

Intervention Two

The participant within the second intervention phase within this investigation was placed under the same conditions (i.e., gym, tricycle) with the researcher recording the same data (i.e., time in exercise, heart rate). All data collected was visually analyzed by the researcher to determine the impact of the intervention (i.e., exercise) on the dependent variable (i.e., stereotypical behaviors). This intervention should be replicable, and the patterns of data points were compared to the data points in the previous baseline phase to determine whether a change in behavior occurred.

Data Analysis

A single subject withdrawal design was used to determine the impact of exercise on the frequency of stereotypical behaviors for a child with ASD. The design allows the researcher to visually analyze all data collected. Within this investigation the researcher will be reporting on

the frequency of stereotypical behaviors demonstrated by the participant across all phases of this investigation.

Level of Behavior

Level of behavior for this investigation will be determined based on the participants performance of the target behavior (i.e., decrease in stereotypical behaviors) post baseline phases (i.e., A_1, A_2; Richards, et al., 2014). This determination was made based on the path (i.e., up, down) of the data following either of the baseline phases (Richards et al., 2014).

Trend

A trend occurs when the scores may be either increasing or decreasing during the baseline and intervention phases. To calculate trend, a straight line connecting the first and last data points in the baseline phase with an arrow at the end to summarize the direction (Nugent, 2000). A similar line would then be drawn for the points in the intervention phase

Descriptive Statistics

For this investigation the mean percentage of stereotypical behaviors during both the baseline phases and intervention phases will be reported. Mean percentage of stereotypical behaviors will be calculated by adding up the total frequency of behaviors demonstrated during each phase and dividing by the total amount of treatment sessions within each phase (Richards et al., 2014).

Frequency

The frequency refers to counting the number of times a behavior occurs. For example, frequency will be recorded at the same time every day. Following the first 15- minutes of warm-up during the participants APE course and on the participants daily documentation form.

Assumptions

The premise is that if the intervention is effective, the target problem should be improved only during course of the intervention. Based on the type of design and data collection the researcher will be analyzing if the total number of stereotypical behaviors exhibited by the participant decreases within the two intervention phases (i.e., B_1, B_2).

CHAPTER III

RESULTS

The purpose of this investigation is to examine the impact of an exercise intervention in reducing stereotypical behaviors in a child with ASD. An A-B-A-B design was implemented to determine if stereotypical behaviors decreased following an exercise intervention. Therefore, the following sections within this chapter will consist of: (a) Participant Demographics, (b) Performance Criteria, (c) Participant Results, and (d) Summary of Results.

Participant Demographics

The participant for this investigation was a female aged 15 years in the 10th grade. Her current height was recorded at 5’1”, and weight 134 lbs. Based on her height and weight, the Center for Disease Control (CDC, 2015) has calculated her body mass index at 24.6. Based on the female BMI of 24.6, the child has been placed in the 88th percentile (i.e., overweight) for girls aged 15 years. According to the CDC, target heart rate should be 50 to 70% of maximum heart rate. At 50% the participants heart rate would need to achieve 102 bpm and at 70% she would need to achieve 144 bpm.

Performance Criteria

Prior to beginning of the study, the guardian, life skills teacher and adapted physical educator reported low levels of exercise in the participant. However, the participant expressed

interest in riding the Rifton Tricycle. Therefore, the experimenter proceeded in a study that the participant would be interested in. Based on EBP, it is recommended that when developing an exercise plan, the length and frequency of the intervention should incorporate at least one routine per day of at least 10-20 minutes, resulting in moderate to vigorous physical exertion. Therefore, a cycling-based intervention was implemented into the participants schedule.

Participant Results

Baseline

For this investigation data was collected for each stereotypical behavior (i.e., body rocking, hand flapping, self-stimulation, vocalization) in intervals (i.e., 15 min) over the span of 5 hours. The researcher began all baseline data collection when the participant arrived in her first period class. Within the baseline phase the participant was allowed to follow her daily schedule with no intervention implemented. Therefore, the results presented for each stereotypical behavior will be reported for each phase within this investigation separately.

Body Rocking

Baseline (A_1)

For the participant body rocking behaviors varied throughout the five baseline treatment sessions. The researcher did notice that body rocking behaviors decreased during the participants APE class from 10:30 to11:15 am (i.e., 6.4 per day). However, following the participants APE class from 11:15 to 12:15 pm (i.e., 24.4 per day) the behaviors for body rocking increased with

the participant demonstrating an average of 30.8 body rocking behaviors per day with a low of 18 (i.e., day 1) and high of 47 (i.e., day 4).

Intervention phase (B_1)

Within the first intervention phase the participant demonstrated a change in her average number of body rocking behaviors from baseline (i.e., 30.8) to intervention (i.e., 22.8). It should be noted that within the intervention phase the participant demonstrated a high of 31 body rocking behaviors for treatment day 6 and a low of 14 during treatment day 7. Therefore, the researcher could presume that the exercise intervention had a positive impact on the overall frequency of body rocking behaviors demonstrated by the participant.

Baseline phase (A_2)

The participant was absent (i.e., day 11) during the second baseline treatment session. The participant returned to the second baseline treatment phase on day 12. For the participant body rocking behaviors decreased during the participants APE class from 10:30-11:15 am (3.8 per day). Following the participants APE class from 11:15-12:15 pm (20.2 per day) the behaviors for body rocking also decreased with the participant demonstrating on average 13.8 body rocking behaviors per day with a low of 9 (i.e., day 13) and high of 24 (i.e., day 12).

Intervention phase (B_2)

Within the second intervention phase the participant demonstrated a change in her average number of body rocking behaviors from the second baseline (i.e., 13.8) to intervention (i.e., 15.8). It should be noted that within the second intervention phase the participant demonstrated a high of 28 body rocking behaviors for treatment day 16 and a low of 15 during treatment day 19. Therefore, the researcher could presume that the exercise intervention has a

positive impact on the overall frequency of body rocking behaviors demonstrated by the participant. See Figure 1.

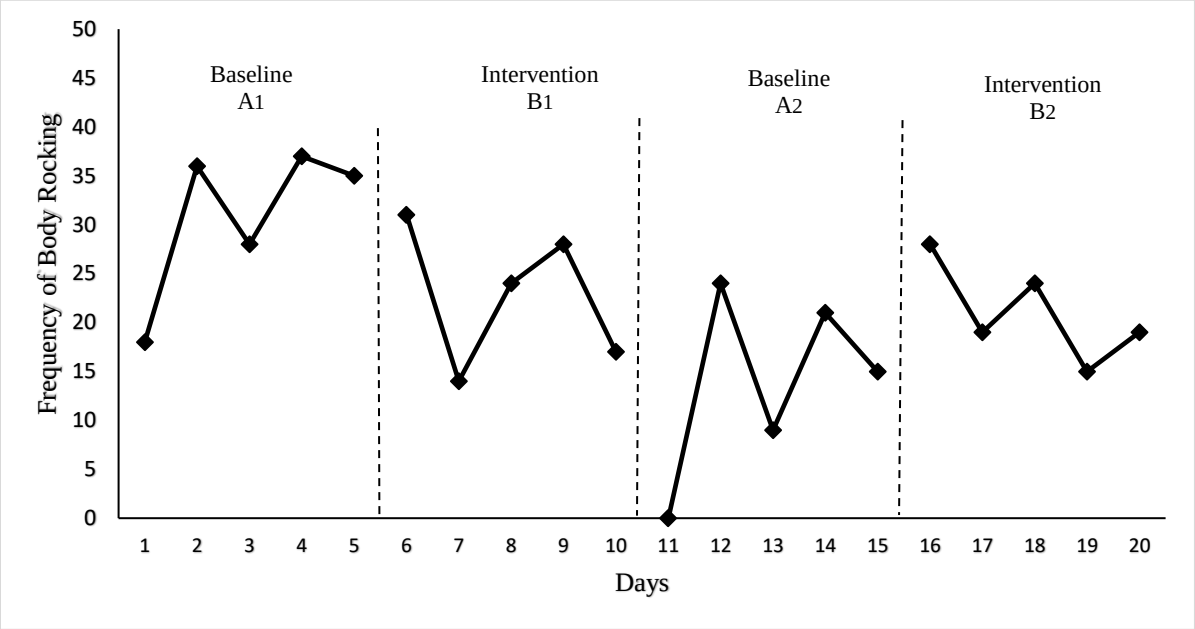

Figure 1. Impact of exercise on the stereotypical behavior of body rocking (A1=First baseline phase, B1=First intervention phase, A2=Second baseline phase, B2=Second intervention phase).

Hand Flapping

Baseline (A_1)

For the participant hand flapping trend was established throughout five baseline treatment sessions. The researcher did notice the hand flapping behaviors decreased during the participants APE class from 10:30-11:15 am (15.5 per day). However, following the participants APE class from 11:15-12:15 pm (22.3 per day) the behaviors for hand flapping increased with the participant demonstrating an average of 37.8 hand flapping behaviors per day with a low of 25 (i.e., day 1) and high of 55 (i.e., day 3).

Intervention phase (B_1)

Within the first intervention phase the participant demonstrated a change in her average number of hand flapping behaviors from baseline (i.e., 37.8) to intervention (i.e., 28.2). It should be noted that within the intervention phase the participant demonstrated a high of 40 hand flapping behaviors for treatment day 10 and a low of 14 during treatment day 7. Therefore, the researcher could presume that the exercise intervention had a positive impact on the overall frequency of hand flapping behaviors demonstrated by the participant.

Baseline phase (A_2)

The participant was absent (i.e., day 11) during the second baseline treatment session. The participant returned to the second baseline treatment phase on day 12. For the participant hand flapping behaviors increased during the participants APE class from 10:30-11:15 am (14.8 per day). Following the participants APE class from 11:15-12:15 pm (24.2 per day) the behaviors for hand flapping also increased with the participant demonstrating on average 39 hand flapping behaviors per day with a low of 35 (i.e., day 12) and high of 68 (i.e., day 15).

Intervention phase (B_2)

Within the second intervention phase the participant demonstrated a change in her average number of hand flapping behaviors from the second baseline (i.e., 39) to intervention (i.e., 27.2). It should be noted that within the second intervention phase the participant demonstrate a high of 33 hand flapping behaviors for treatment day 20 and a low of 18 during treatment day 18. Therefore, the researcher could presume that the exercise intervention has a positive impact on the overall frequency of hand flapping behaviors demonstrated by the participant. See Figure 2.

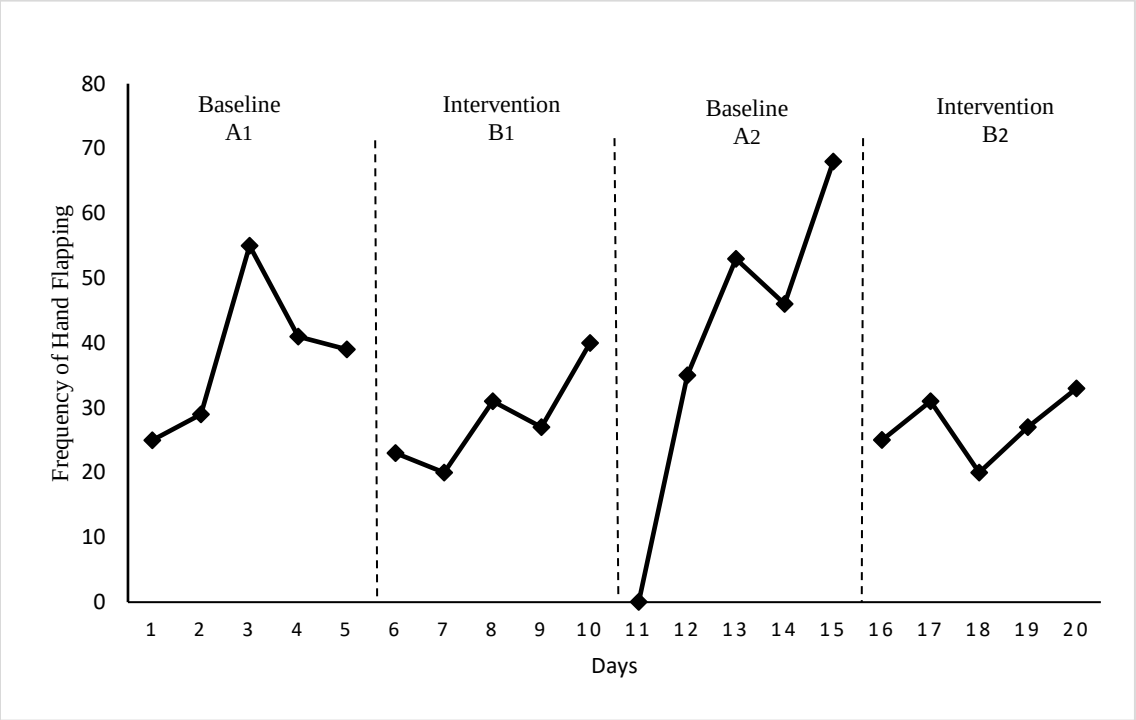

Figure 2. Impact of exercise on the stereotypical behavior of hand flapping (A1=First baseline phase, B1=First intervention phase, A2=Second baseline phase, B2=Second intervention phase).

Self-Stimulation

Baseline (A_1)

For the participant self-stimulation behaviors varied throughout the five baseline treatment sessions. The researcher did notice that self-stimulation behaviors decreased during the participants APE class from 10:30 to11:15 am (0 per day). However, following the participants APE class from 11:15 to 12:15 pm (1.2 per day) the behaviors for self-stimulation increased with the participant demonstrating an average of 1.2 self-stimulation behaviors per day with a low of 0 (i.e., day 3 and 5) and high of 2 (i.e., day 1,2 and 4).

Intervention phase (B_1)

Within the first intervention phase the participant demonstrated a change in her average number of self-stimulation behaviors from baseline (i.e., 1.2) to intervention (i.e., 0). It should be noted that within the intervention phase the participant demonstrated a high and low of zero self-stimulation behaviors for every treatment day. Therefore, the researcher could presume that the exercise intervention had a positive impact on the overall frequency of self-stimulation behaviors demonstrated by the participant.

Baseline phase (A_2)

The participant was absent (i.e., day 11) during the second baseline treatment session. The participant returned to the second baseline treatment phase on day 12. For the participant self-stimulation behaviors decreased during the participants APE class from 10:30-11:15 am (0 per day). Following the participants APE class from 11:15-12:15 pm (0.8 per day) the behaviors for self-stimulation increased with the participant demonstrating on average 0.8 self-stimulation behaviors per day with a low of 0 (i.e., day 11 and 12) and high of 3 (i.e., day 14).

Intervention phase (B_2)

Within the second intervention phase the participant demonstrated a change in her average number of self-stimulation behaviors from the second baseline (i.e., 0.8) to intervention (i.e., 0.2). It should be noted that within the second intervention phase the participant demonstrate a high of 1 self-stimulation behaviors for treatment day 16 and a low of 0 during treatment day 17-20. Therefore, the researcher could presume that the exercise intervention has a positive impact on the overall frequency of self-stimulation behaviors demonstrated by the participant. See Figure 3.

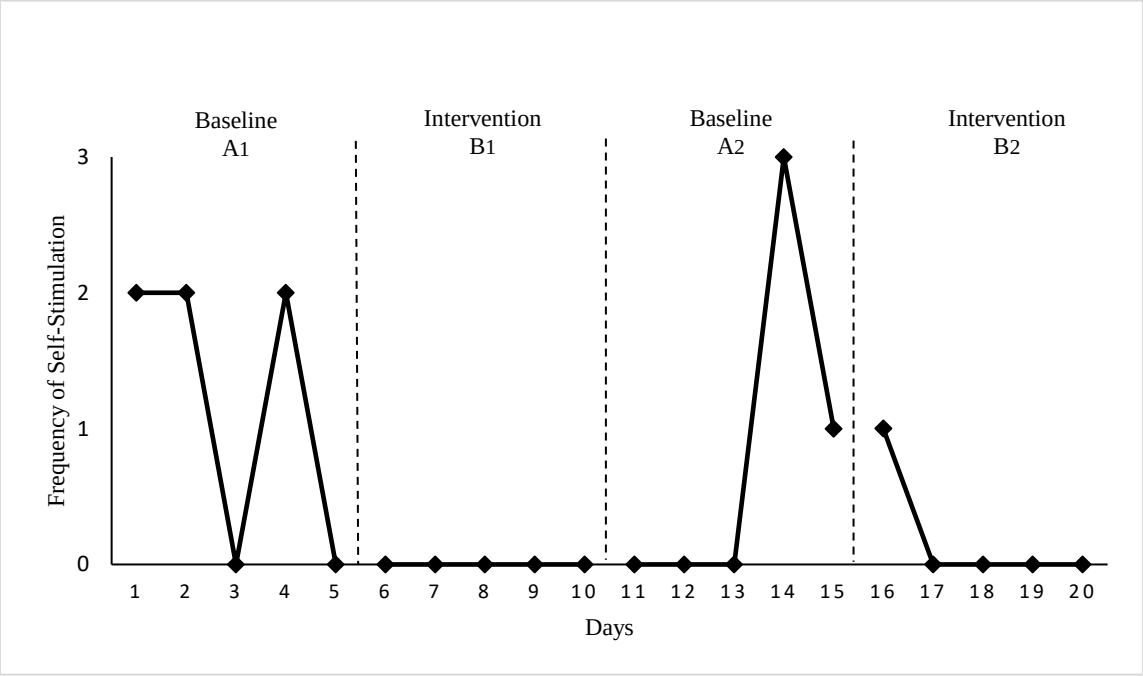

Figure 3. Impact of exercise on the stereotypical behavior of self-stimulation (A1 = First baseline phase, B1= First intervention phase, A2 = Second baseline phase, B2 = Second intervention phase).

Vocalizations

Baseline (A_1)

For the participant vocalization behaviors varied throughout the five baseline treatment sessions. The researcher did notice that vocalizations behaviors decreased during the participants APE class from 10:30 to11:15 am (11.2 per day). However, following the participants APE class from 11:15 to 12:15 pm (12.8 per day) the behaviors for vocalization increased with the participant demonstrating an average of 24 vocalization behaviors per day with a low of 14 (i.e., day 1) and high of 42 (i.e., day 3).

Intervention phase (B_1)

Within the first intervention phase the participant demonstrated a change in her average number of vocalization behaviors from baseline (i.e., 24) to intervention (i.e., 14.8). It should be noted that within the intervention phase the participant demonstrated a high of 22 vocalization behaviors for treatment day 8 and a low of 8 during treatment day 6. Therefore, the researcher could presume that the exercise intervention had a positive impact on the overall frequency of vocalization behaviors demonstrated by the participant.

Baseline phase (A_2)

The participant was absent (i.e., day 11) during the second baseline treatment session. The participant returned to the second baseline treatment phase on day 12. For the participant vocalization behaviors decreased during the participants APE class from 10:30-11:15 am (6.2 per day). Following the participants APE class from 11:15-12:15 pm (17.4 per day) the behaviors for vocalization increased with the participant demonstrating on average 23.6 vocalization behaviors per day with a low of 16 (i.e., day 12) and high of 36 (i.e., day 15).

Intervention phase (B_2)

Within the second intervention phase the participant demonstrated a change in her average number of vocalization behaviors from the second baseline (i.e., 23.6) to intervention (i.e., 16.6). It should be noted that within the second intervention phase the participant demonstrate a high of 20 vocalization behaviors for treatment day 17 and a low of 11 during treatment day 19. Therefore, the researcher could presume that the exercise intervention has a positive impact on the overall frequency of vocalization behaviors demonstrated by the participant. See Figure 4.

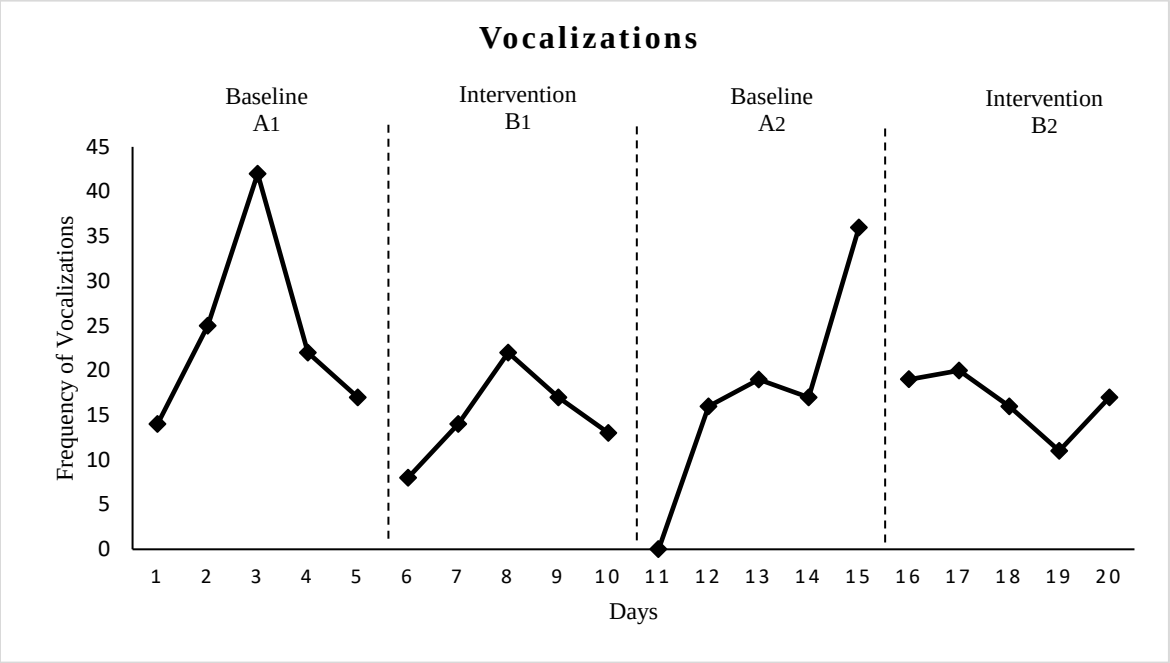

Figure 4. Impact of exercise on the stereotypical behavior of vocalizations (A1= First baseline phase, B1 = First intervention phase, A2 = Second baseline phase, B2 = Second intervention phase).

Motivation

Results indicate that extrinsic motivation (i.e., reward) can promote time spent engaged in an exercise intervention for a child with ASD. This finding is consistent with other research (Shapiro, 2003) indicating that higher external motivation lead to increased exercise levels for a child with ASD. For example, the participant cycling was provided with a choice that allowed her to choose a reward following exercise.

Heart Rate

Throughout the intervention phase, the participant exercised at moderate levels (56%) of intensity. Her average heart rate during week two of the intervention (i.e., B1) was 114.4 beats

per minute (bpm). Throughout the second intervention (i.e., B2) her average heart rate decreased to 107.4 bpm. The resting and peak heart rate had no significance in the outcome of the stereotypical behaviors. However, it provided the researcher with additional information in determining the level of exercise achieved. See table 1.

Table 1. Heart Rate Throughout the Intervention

Average Heart Rate	**A1**	**B1**	**A2**	**B2**
Resting HR	0	56	0	68.6
Average HR	0	114.4	0	107.4
Peak HR	0	147.2	0	154.6

Behaviors Overall

Figure 5 provides an overall presentation of the stereotypical behaviors observed during baseline and intervention phases and Table 2 illustrates the average frequency of each stereotypical behavior throughout a four-week intervention. When interpreting Figure 5, results indicate that an exercise intervention has the potential to decrease stereotypical behaviors in this child with ASD (i.e., hand flapping, self-stimulation and vocalizations). Subtle changes occurred in the stereotypical behavior body rocking.

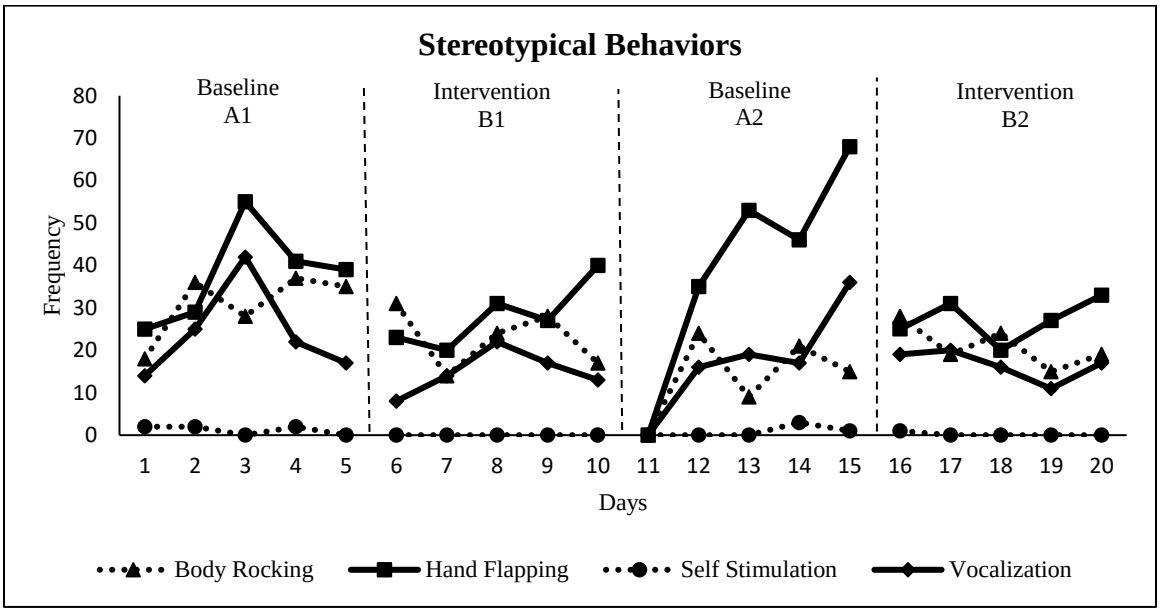

Figure 5. Impact of exercise on the frequency of stereotypical behaviors (A1 = First baseline phase, B1 = First intervention phase, A2 = Second baseline phase, B2 = Second intervention phase).

Table 2. Average Frequency of Stereotypical Behaviors per Week

Stereotypical Behaviors	**Week 1**	**Week 2**	**Week 3**	**Week 4**
Body Rocking	30.8	22.8	13.8	15.8
Hand Flapping	37.8	28.2	39	27.2
Self-Stimulation	1.2	0	0.8	0.2
Vocalizations	24	14.8	23.6	16.6

Summary of Results

Based on an analysis of the child, an exercise intervention will decrease stereotypical behaviors in a child with ASD. In addition, EBP has proven to be an effective intervention in addressing motor, behavior, school readiness, and academic outcomes. Therefore, when developing an exercise plan, the length and frequency should be at least 10-20 minutes and result in moderate to vigorous physical exertion.

CHAPTER IV

DISCUSSION

The purpose of this study was to investigate the impact of an exercise intervention in reducing stereotypical behaviors in a child with ASD. Children with ASD often lack the motivation to exercise for sustained periods, which is necessary to acquire the health benefits associated with physical activity (Reid & Todd, 2006). Research suggests that extrinsic motivators (i.e., rewards) are necessary for learning (Sprinthall & Oja, 1998). As rewards are perceived from most desirable to least desirable, the participant will act on her highest level of motivation (Mercer & Witzel, 2003). Educators can increase motivation in children with ASD by changing activities frequently, using different learning stations, and planning transitions to help overcome short attention spans (O'Connor et al., 2000). In addition, the participant received regular attention and encouragement, which may have been responsible for some increase in participation and is consistent with results from previous research (Lombard & Winett, 1995; Weber & Wernheim, 1989). Positive reinforcement was added to the environment as an attempt to reinforce desired behaviors (Mercer & Witzel, 2003).

Results of this study indicate that a cycling-based intervention, five times throughout the school week can be effective in decreasing the frequency of stereotypical behaviors in a child with severe (Level 3) ASD. For example, research has shown exercise programs used as interventions for a variety of developmental and psychiatric disorders (Lambourne, Okumura & Tomporowski, 2003), have overall positive effects on reducing stereotypical behavior (Petrus et

al., 2008). The results revealed no consistent behavioral changes across the study. However, the student's frequency of stereotypical behaviors decreased throughout the intervention phases. Levinson and Reid (1993) also found similar results following a treatment (i.e., vigorous activity) that resulted in significant reductions in stereotypical behaviors. In addition, researchers have reported a reduction in stereotypical behavior patterns of children with ASD following aerobic exercise (Dobbin, Elliott, Rose & Soper, 1994; Birjan, Bumin, Yanardag & Yilmaz, 2004). These results demonstrate the importance of implementing daily exercise programs for children with ASD.

While stereotypical behaviors have always been shown to decrease immediately after physical exercise-based interventions (Kern et al., 1984; Powers et al., 1992; Reid et al., 1988), these behaviors seemed to gradually increase and return to baseline levels over a 40 min (Celiberti et al., 1997) to 90 min (Levinson & Reid, 1993) period of rest. Researchers have considered the result (decreases in stereotypical behavior following physical exercise) in relation to the effects of fatigue resulting from exercise. It is noteworthy that fatigue may have been a possible explanation for the decreases in stereotypical behaviors for the participant in this study. Stereotypical behaviors were assessed immediately following the cycling-based intervention every day.

The stereotypical behaviors and cycling program the participant received may account for the reductions of stereotypical behavior in the present study. Lang et al. (2010) claim that the similarity of the physical stimulation obtained via physical exercises for children with ASD may contribute to reductions in stereotypical behaviors. Researchers have hypothesized that physical exercises would reduce stereotypical behaviors by providing children with ASD with similar

sensory feedback in an appropriate way (Watters & Watters, 1980). In addition, researchers have documented the benefits of physical exercise in children with ASD (Bachman & Sutter, 1988; Fong, Ng & Tsang, 2012) and have suggested that regular exercise has beneficial effects in alleviating social, behavioral, cognitive, and motor impairments for children with ASD (Ashbaugh et al., 2010; Muelenbroek & Sowa, 2012).

It is assumed that cycling provides children with social benefits as well as physiological health benefits. The skill of cycling during adolescence is widely accepted as a societal norm. The absence of such a skill likely places the child with ASD at a disadvantage, hindering their ability to engage in shared activities with their same-aged peers as well as participate in a motor skill with direct relevancy to daily life (Burt et al., 2007). Therefore, it is imperative that exercise interventions such as cycling be considered as an APE programming option so that more children with ASD are afforded the social and physiological health benefits provided by cycling.

CONCLUSION

This investigation demonstrated a cycling-based intervention has the potential to decrease stereotypical behaviors in children with ASD. The findings of the present study may help future researchers establish an EBP under which cycling will be instructed to children with ASD.

RECOMMENDATIONS FOR FUTURE RESEARCH

Stereotypical behaviors are not likely to decrease without intervention (Carr, Horner, Reed, Strain & Todd, 2002). To facilitate the success of children with ASD, it is crucial to identify strategies instructors use to reduce the occurrence of stereotypical behaviors (Asmus, Conroy, Ladwig & Sellers, 2005). Thus, researchers must continue to develop new and innovative approaches to decrease the behavior (Lanovaz, 2011). Given the severity of these problems, it is advantageous to treat stereotypical behaviors before it can lead to more serious problem behaviors (McLaughlin, 2010). This investigation showed that cycling when used as an exercise intervention can be an effective tool and an innovative approach to decrease stereotypical behaviors in children with ASD.

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APPENDIX A

Daily Documentation Form Observer: _____ Date: _____

Time	MONDAY			
	Body Rocking	**Hand Flapping**	**Self Stimulation**	**Vocalization**
8:00-8:15am				
8:15-8:30am				
8:30-8:45am				
8:45-9:00am				
9:00-9:15am				
9:15-9:30am				
9:30-9:45am				
9:45-10:00am				
10:00-10:15am				
10:15-10:30am				
10:30-10:45am				
10:45-11:00am				
11:00-11:15am				
11:15-11:30am				
11:30-11:45am				
11:45-12:00pm				
12:00-12:15pm				
12:15-12:30pm				
12:30-12:45pm				
12:45-1:00pm				

Body Rocking: Rhythmic Movement (i.e., back and forth) for 1 second
Hand Flapping: Holding hands or fingers up in the air or to ears for 1 second
Self Stimulation: Mouthing or rubbing parts of one's body for 1 second
Vocalization: A vocal stimulus in the immediate environment