THE EFFECTS OF PHYSICAL ACTIVITY ON THE STEREOTYPIC BEHAVIORS OF CHILDREN WITH AUTISM SPECTRUM DISORDER

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ABSTRACT

The purpose of this study was to examine the effects of physical activity on stereotypical behaviors of children with autism spectrum disorder (ASD). Twenty-three children age 5-13 years (6 female and 17 males) participated in this study. Children were asked to participate in 15 min moderate to vigorous physical activity a day. Physical activity was identified as moderate or vigorous based on the child's heart rate. The child was observed for two and a half hours each day and their behaviors were then classified as either stereotypic behavior or task-engaged behavior. The heart rate data suggested that all children engaged in moderate to vigorous physical activity. No significant behavior differences related to exercise on age, gender, and disorder. However, children significantly decreased their stereotypic behaviors, indicating that moderate to vigorous physical activity participation could reduce the amount of stereotypic behaviors for children with ASD regardless of age, gender, and disorder. This suggests that physical activity is a method of modifying stereotypic behaviors in children with ASD.

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INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurological disorder affecting about 1 in 88 U.S. children (CDC, 2012). ASD is usually diagnosed during childhood and is characterized by some core symptoms that include qualitative impairment in social interaction, delays in the development of communication, restrictive interests, and repetitive body movements. ASD includes Asperger syndrome, autism, and pervasive developmental disorder not otherwise specified (PDD-NOS) (CDC, 2012; NICHD, 2012; Sturmey & Fitzer, 2007). As of now, there is no cure or consistent known means of treating the symptoms (Burns & Ault, 2009; NICHD, 2012). Several interventions are typically used for ASD treatment such as occupational therapy, horseback riding, medication, and applied behavior analysis (Burns & Ault, 2009). All of these interventions are usually focused on attempting to reduce stereotypic behaviors in children with ASD because these types of behaviors can be extremely disruptive in social situations (Burns & Ault, 2009).

Because ASD is classified as a sensory disorder, it is believed that the stereotypic behaviors associated with ASD are an attempt on the individual's part to provide him or herself with sensory feedback (Powers, Thibadeau, & Rose, 1992; Purpas & Reid, 2001). These stereotypic behaviors are self-stimulatory, non-functional, and repetitive in nature and can take the form of rocking, hand flapping, and gazing (Burns and Ault, 2009; Levinson & Reid, 1993; Power, Thibadeau, & Rose, 1992; Rosenthal-Malek & Mitchell, 1997). Therefore, it is difficult to achieve a reduction in stereotypic behaviors (Purpas & Reid, 2001). On the other hand, the reduction of these stereotypic behaviors is important because they are often inappropriate and interfere with social and learning situations in

children with ASD (Burns & Ault, 2009). Stereotypic behaviors may cause children to have anxiety when placed in social settings and can lead to apprehension or withdrawal from participating in group situations and interactions with others. Unwillingness to integrate socially can prevent a child from acquiring appropriate social and communication skills (Powers, Thibadeau, & Rose, 1992).

Many times stereotypic behavior and maladaptive behavior are associated with one another. Stereotypic behaviors are considered problematic because they reduce attention and many times interfere with the task at hand (Bass, 1985; Campbell, 2003; Kern, Koegel, Dyer, Blew, & Fenton, 1982; Sugai & White, 1986). When these stereotypical inappropriate behaviors occur in a social setting, they can result in frustration or aggression as children interacting with peers or authority figures. Maladaptive behaviors include aggression, self-injury, or property damage (Elliot, Dobbin, Rose, & Super, 1994). Oftentimes with a reduction in stereotypic behaviors, maladaptive behaviors also decrease because the child can better focus on the directions and tasks. Stereotypic behaviors prevent children from appropriately responding to their environment and interfere with the learned behaviors causing integration problems (Bucher & Lovaas, 1968; Levinson & Reid, 1993; Sugai & White, 1986). Furthermore, children with ASD who engage in stereotypic behaviors can be difficult to reach and oblivious to external stimulation (Lovass, Newson, & Hickman, 1987; Van Bourgondien & Mesibov, 1989). This creates a gateway for maladaptive behaviors to surface in a classroom or home setting when the individual is unwilling to properly respond to his or her environment. Therefore, it is a priority to reduce stereotypic behaviors so that positive responses can occur instead of maladaptive behaviors.

Physical activity is known to promote good mental and physical health in the general population (Pan & Frey, 2006; Sowa & Meulenbroek, 2012). Exercise is now widely accepted as a technique to reduce stereotypical and maladaptive behaviors in children with ASD (Kern et al., 1982; Levinson & Reid, 1993; Purpas & Reid, 2001; Rosenthal-Malek & Mitchell, 1997). The earliest evidence for physical activity as a form of decreasing stereotypical and maladaptive behavior comes from the reports of special education teachers who stated that students with ASD appeared more attentive and cooperative after physical activities such as gym, field trips, or outdoor activities (Burns & Ault, 2009). Many studies have looked at the effect of physical activity on the reduction of stereotypical behaviors (Kern et al., 1982; Reid, Factor, Freeman, & Sherman, 1988; Rosenthal-Malek & Mitchell, 1997; Watters & Watters, 1980). Lang et al. (2010) reported that regular and specific types of physical activity could benefit individuals with ASD in regulating their stereotypic behaviors. Although exercise cannot eliminate stereotypic behaviors, it may alter the response from inappropriate to appropriate (Purpas & Reid, 2001). This leads to better behavior responses and a decrease in maladaptive behaviors (Elliot et al., 1994).

The positive health benefits combined with its relative ease of implementation make physical activity a preferred strategy for behavior modification in children with ASD (Purpas & Reid, 2001). Burns and Ault (2009) concluded that the participants only needed to spend 5-8 minutes on the treadmill to still yield favorable behavior results, supporting the idea that physical activity can be an easy form of intervention for children with ASD. Favorable behavior results typically means a decrease in the stereotypic behavior and aggression with an increase in attention. Physical activity can be a method

of preventative behavior management; parents and teachers can use exercise to address stereotypical behaviors before they start as an alternative of using medication or negative consequences after the behavior occurs (Burns & Ault, 2009; Elliot et al., 1994; Kern et al., 1982).

As stated, physical activity provides additional health benefits that other forms of behavior modification do not. Curtin, Anderson, Must, and Bandini (2010) found that children with ASD are more likely to be obese than children without ASD. Furthermore, children who are obese have an increased risk of several other health problems such as cardiovascular problems, joint problems, Type 2 diabetes, and sleep apnea. Murphy and Carbone (2008) stated that children with disabilities gained the same benefits from physical activity as children without disabilities. Some specific benefits of physical activity for children with ASD include reduction of low-density lipoproteins while increasing high-density lipoproteins, improvement of glucose metabolism in patients with Type II diabetes, strength, self-esteem and body image, and reduction in the occurrence of back injuries (Sothern, Loftin, Suskind, Udall, & Blecker, 1999).

One drawback of using physical activity, as a form of intervention for children with ASD, is that deficiencies usually present themselves in three areas: motor ability, communication, and social skills (Sowa & Meulenbroek, 2012). The deficits in motor proficiency often cause children with ASD to be unwilling to participate in physical activity (Koegel, Koegel, & McNerney, 2001; Reid, O'Connor, & Lloyd, 2003). Furthermore, team sports or group exercise can also be a challenge because of social skill limitations (Todd & Reid, 2006). Unfortunately, this leads to most individuals with ASD living sedentary lifestyles (Todd & Reid, 2006). Therefore, when attempting to motivate

children with ASD to participate in physical activity, it may be best to choose individual activities with low motor and coordination skill levels (Todd & Reid, 2006). To get children with ASD to participate, it may be better to choose activities that already relate to play or are chosen by the child.

Several issues exist concerning the effects of physical activity on stereotypic behaviors. One issue is that there is a lack of consistency on research methodology. Researchers use intensity terms such as mild, moderate, and vigorous physical activity without really defining the parameters that constitute each type of exercise (Burns & Ault, 2009). Another is that there is a lack of research for how long the effect of physical activity lasts. Although, we know that physical activity can decrease stereotypical behavior, the duration of how long the child's stereotypic behavior decreases is unknown. Finally, according to research, there are challenges in successfully motivating children with ASD to participate in physical activity. Our study differed because we defined our type of physical activity using heart rate, documented the child's behavior over a span of two hr to see how long stereotypic behavior decreased, and we chose fun and motivational activities over a regimented exercise routine. Therefore, the purpose of this study was to examine the effect of physical activity (intensity measured by heart rate) on the stereotypic behaviors associated with children with ASD.

METHOD

Participants

Participants were recruited from the Texas State University Autism Summer Camp. Twenty-three children (6 females and 17 males) participated in the study. All were

diagnosed with ASD and according to parent surveys; eight were diagnosed with autism, seven with PDD-NOS, and eight with Asperger's Syndrome. The children's age ranged from five to 13.

Participants attended any number of four one-week camp sessions. During the child's first day at the camp, an observation screening was made to check if the child would be a good candidate to include in the study. Specific attention was given to document the child's behaviors, willingness to be active, and interaction with other children. Children's behaviors were classified as "stereotypic" or "task-engaged" behaviors. Stereotypic behavior (SB) was defined as the child not participating in activities in an appropriate manner. For example, a child refused to follow directions, not transitioning from one activity to the next, hitting, screaming, crying, aggression, or throwing items. Task-engaged behavior (TE) was defined as the child acting appropriately in the current situation while listening to directions as well as interacting well with others. The screening information on stereotypic and task-engaged behavior was used as children's baseline data before their participation in physical activity. Children's behaviors were then recorded as they participated in physical activities such as stationary biking, trampoline, dance video game, obstacle courses, basketball, and tag. Children who were often seen engaging in stereotypic behavior, willing to participate in physical activity, and could follow direction were included in the study.

Each parent with a description of the study provided written consent. Children's medical histories were used to ensure that they could participate in physically demanding activities. Children that had been given limited physical activity orders by a physician

were excluded from the study. All children in this study had a history of some stereotypic behaviors at home or in a school setting.

Procedure

For 2.5 hr each day, documentation was taken on each child's behavior. After moderate to vigorous physical activity participation, children were recorded as either engaging in SB or TE for 15 min intervals. SB was recorded if they screamed, hit, refused to follow directions, showed aggression, engaged in any activity that could damage property, or threw a tantrum at any point during the fifteen minutes. If the child was engaged in an appropriate activity, followed instructions, and had no instances of SB during the fifteen minutes, a TE was recorded.

The child's counselor and the camp staff, by encouraging the child to engage in a physically demanding activity each day, administered the physical activity. The child could pick the activity in which he or she wanted to participate. The staff provided certain activities based on the fact that they would raise the child's heart rate to the desired level such as: jumping on a trampoline, stationary biking, swimming, or completing an obstacle course. Several group activities were also offered such as red light/green light, parachute, and tag. The goal was to encourage the child to participate in moderate to vigorous physical activity for 15 min a day. After the child selected and completed his or her desired activity, the camp staff would read the heart rate monitor, record the heart rate and intensity of activity, and document the behavior the camper displayed after participating in the physical activity. This procedure was done each day of the four-day camp week for every session the child attended.

The types of physical activity were designed with idea that getting children with ASD to participate in physical activity can sometimes be challenging. The exercises were designed to appeal to children by having some aspects of play involved. For example, the stationary bike used in this study was equipped with a television screen that displayed a video game prompting the participant to pedal faster to win. Another game-like technique used to motivate the children to want to participate in moderate to vigorous activity was to provide the children with a dance pad game that made them use their feet to correspond to symbols displayed on a screen. In addition, once a week the children would have a swim day. On the swim day, physical activity was typically conducted at the pool. Counselors would encourage children to swim laps, dive for pool toys, or play red light/green light as a group.

Due to the fact that there was no specific exercise regimen given for each child to participate in, heart rate was used to determine the intensity of physical activity. While the child engaged in physical activity, he or she would wear a wrist heart rate monitor. If the child's heart rate was between 100-120 beats per min, the physical activity was classified as moderate while 121-140 beats per min was labeled as vigorous intensity (Jago et al., 2009). An exception was pool days; on these days, the heart rate watch was placed on the child after the activity had taken place and assessed in the same way.

Data Analysis

Descriptive statistical analyses were used to describe the SB and physical activity intensity. Behavior data were collected for a week and then transferred to quantitative data by finding the percentage of time each day the child spent participating in SB or TE. The SB data were averaged from all day's behavior data. A 2 (age) x 2 (gender) x 3

(disorder) ANOVA (analysis of variance) was conducted on SB using Statistical Package for the Social Sciences (SPSS). Further, a paired t-test was run to analyze percentage of SB before and after the children engaged in physical activity. Results were considered significant if the alpha level was .05. In addition to statistically significant findings, effect size was determined for practical significance using Cohen's *d* (Cohen, 1988).

RESULTS

All the children (100%) engaged in moderate to vigorous intensity level during physical activity participation. Reduction of SB after physical activity lasted for about 2 hr according to TE and SB descriptive analyses. The ANOVA analysis did not reveal significant difference for SB on age, gender, and disorder. The paired t-test showed that children significantly decreased their SB after physical activity engagement ($t_{22} = 3.994$, $p = .001$). Physical activity reduction effect on stereotypic behaviors lasted for about 2 hr for children with ASD. These results suggested that participation in physical activity reduced stereotypic behaviors for children with ASD regardless of age, gender, or types of ASD. About 15 min moderate to vigorous physical activity a day would significantly reduce children's stereotypic behavior for 2 hr. Means and standard deviations of children's SB percentage before and after participation of physical activity are presented in Figure 1.

The effect size (ES) describing exercise effects on children with ASD stereotypic behaviors between before and after physical activity participation was large ($d = 1.35$). The ES result indicated that the true effect in the population might be large.

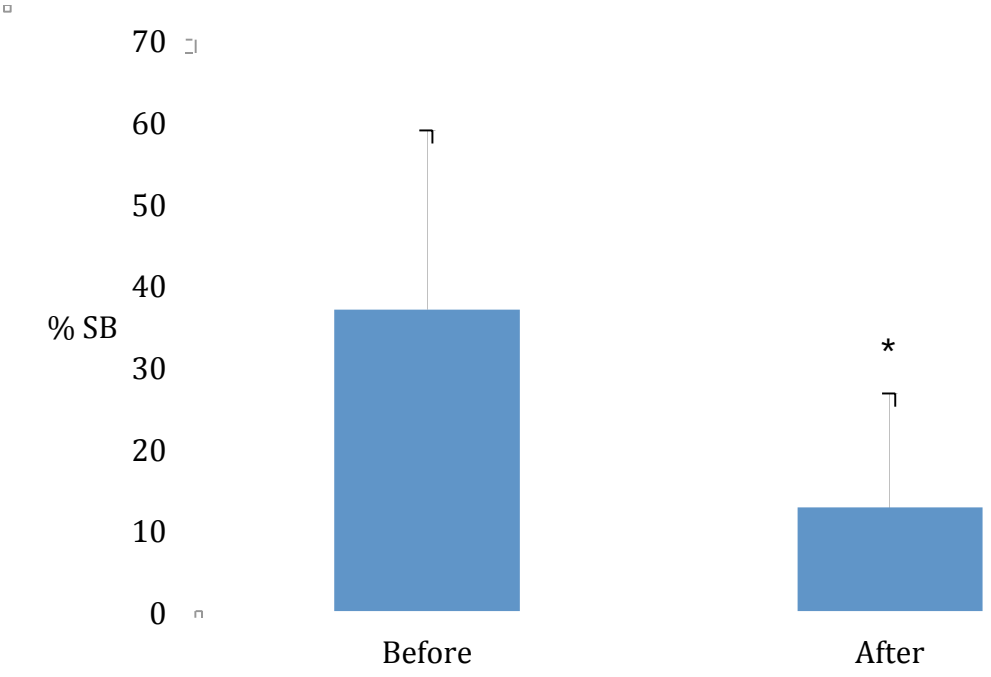

***Figure 1*. Significant Change in Percentage of SB Before and After Physical Activity.**

DISCUSSION

The purpose of this study was to determine the effects of physical activity engagement on stereotypic behaviors in children with ASD. The results of this study indicated that only 15 min moderate to vigorous physical activity participation helped children with ASD to decrease the amount of stereotypic behaviors for about 2 hr. This finding is consistent with several previous studies that found exercise to be beneficial for children with ASD stereotypic behaviors (Kern et al., 1984; Levinson & Reid, 1993; Reid et al., 1988; Rosenthal-Malek & Mitchell, 1997; Watters & Watters, 1980).

The importance of our finding has some positive implications. First, because stereotypic behaviors create a barrier to integration and severe behavior problems can result in children being removed from the classroom (Elliot et al., 1994). Physical education classes and recess can be used to help children with ASD to perform in the

classroom because it raises their heart rate and can result in a decrease in stereotypic behaviors that inhibit learning in the classroom setting. Secondly, parents can use this information to help control their children's stereotypic behavior problems at home. By simply taking their child on a walk, bike ride, or to the park for about 15 min, they may see a significant decrease in SB at home and that effect may last for 2 hr.

The results also showed no difference between age, disorder, and gender. This suggests that most children with ASD can gain positive effects from physical activity because no specific exercise regiments need to be prescribed for children in different age ranges, gender, or disorder. This finding helps practitioners and educators in designing behavior treatment for children with ASD because moderate to vigorous physical activity may help decrease and limit stereotypic behaviors. Allowing children with ASD to participate in physical activities with their peers, benefits them by involving in social situations and helping minimize problem behaviors.

Another implication of this study is the advantage of the many health effects that exercise could have on children with ASD. Studies show that children with ASD are at risk for much nutritional deficiency and health risks brought on by lack of exercise because of their lack of motivation to be physically active and their selective diets (Koegel, Koegel, & McNerney, 2001; Reid, O'Connor, & Lloyd, 2003; Todd & Reid, 2006). Because many times it was difficult to get the children to engage in physical activity, this finding could help children with ASD to get more involved and be active.

One limitation of this study is that each child is differently affected by the disorder, thus making it extremely difficult to make generalizations about how treatment options such as exercise will affect each child's behavior (Burns & Ault, 2009).

Therefore, our findings can only be generalized to children with similar age and disorder. Another limitation of this study is that there were days where the child refused to participate in physical activity of any kind. In those situations, children received the documentation of CB for the whole two and a half hours and no data on heart rate or type of activity could be gathered. This leaves some inconsistencies in the data, making it hard to determine patterns and draw conclusions.

More research needs to be conducted the effects of exercise lasted in decreasing the occurrence of stereotypic behavior once the child left the camp. It would be interesting to know whether the children who attended camp for four weeks and participated in regular physical activity throughout that time showed any improvements at home or school in the following days and weeks. During this summer's camp sessions, we plan to ask parents to evaluate their children's behavior at home so we may see if physical activity continues to benefit the child throughout the whole day. In addition, researchers should also look to see if any effect differences arise between play-exercise, as done in this study, and traditional jogging or other more structured exercise. A comparison study would help us see if one type of physical activity helped decrease stereotypic behaviors over the other.

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