

THE EFFECTS OF CIRCUIT TRAINING ON DECREASING OFF-TASK  
BEHAVIORS FOR CHILDREN WITH AUTISM SPECTRUM DISORDER

By

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## ABSTRACT

### THE EFFECTS OF CIRCUIT TRAINING ON DECREASING OFF-TASK BEHAVIORS FOR CHILDREN WITH AUTISM SPECTRUM DISORDER

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Autism spectrum disorder (ASD) is the fastest growing developmental disability according to Centers for Disease Control and Prevention (CDC). Prevalence shows that 1 in 59 children are born with Autism Spectrum Disorder, and having this population engage in physical activity will reduce off-task behavior. The purpose of this study is to determine the benefits of circuit training on decreasing off-task behavior while improving health for children with Autism Spectrum Disorder, and encourage parents, teachers, and specialist to incorporate similar drills, activities, and exercises with the ASD population. In this study, a special education high school teacher and APE instructor will choose four students who have off-task behavior and are diagnosed with ASD to participate in this study.

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## CHAPTER 1

### Introduction

Autism spectrum disorder (ASD) is the fastest growing neurodevelopmental disorder with one in 59 children in the United States being diagnosed (CDC, 2019). Exercise has many benefits for children with ASD, such as decreasing stereotypic and inappropriate behaviors (CDC, 2019; Watters & Watters, 1980). Due to social and communication skill deficits, having children with ASD participate in regular exercise or team sports, instead of isolated activities may be difficult (Menear & Neumeier, 2015). In most cases, children with ASD lack social interaction or communication skills, which prevents them from interacting in physical activity and team sports and instead, they engage in isolated activities (Winnick, 2011). The CDC (2019) reported that less than a third of children including those with ASD meet the established Physical Activity Guidelines for Americans (CDC, 2019). Alternative exercise programs, such as agility stations or circuit training, which require less socializing and tactical awareness, may be a good way to meet the physical activity needs for this population.

### Autism Spectrum Disorder

ASD is a neurodevelopmental disorder that acts as an umbrella term for children who are diagnosed with four separate disorders, including Autism, Asperger's syndrome, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified (American Psychiatric Association [APA], 2013). Children who are diagnosed

with ASD have core characteristic deficits in social skills and communication skills, and display repetitive and stereotypical behaviors, which make adapting to change within their environment difficult (APA, 2013). A child can be diagnosed with ASD as early as 18 months, but most are diagnosed after the age of three (CDC, 2019; Winnick, 2011). Due to different levels of severity children with ASD can be diagnosed at three different levels (i.e., Level 1,2,3). A Level 1 diagnosis requires consistent support throughout the child's day, while a Level 2 diagnosis requires substantial support, and a Level 3 diagnosis requires substantial support at all times (APA, 2013)

### Exercise

Exercise can be defined as a subcategory of physical activity, which is planned, structured, repetitive, and has a purpose of improving or maintaining physical fitness (Caspersen, Powell, & Christenson, 1985). Exercise has three levels of intensity, which include light, moderate, and vigorous, and could include activities, such as walking, jogging, bicycling, and swimming. The California Nutrition and Physical Activity Guidelines for Adolescents (2015) recommends children between the age of 6 to 17, participate in 60 minutes or more of moderate to vigorous daily physical activity (Guidelines and Resources for Adolescents, 2015: Rajbhandari, 2015). In addition, adolescents who participate in exercise from a young age are more likely to continue physical activity later in life (Rajbhandari, 2015).

## Off-Task Behaviors for Children With ASD

ASD is a neurodevelopmental disorder that impacts a child's ability at different levels to communicate, socialize, and be involved in many of the same activities as his or her typically developing peers (CDC, 2019). ASD is a spectrum, and therefore the likelihood of two children demonstrating the same behaviors is unlikely (APA, 2013). Because of these deficits associated within the population staying on-task for children with ASD may be difficult. In 2014, the National Professional Developmental Center on Autism Spectrum Disorder identified exercise as an evidence-based practice (Evidence-Based Practices | Autism PDC, 2017). Benefits from consistent bouts of exercise (i.e., jogging in the school yard for 8-10 minutes) have demonstrated a reduction in off-task behaviors (i.e., hand flapping, rocking, spinning, and torso movements) for children with ASD (Watters & Watters, 1980).

## Circuit Training

Circuit training is a program of mixed resistance, aerobic and flexibility exercises performed in sequence at a series of stations and can benefit children with ASD in both aerobic and anaerobic capacity, as well as self-regulation (Mauro & Cermak, 2006; Quinn, 2018). Incorporating activities and exercises that require pressure to muscles, joints, and bones such as jumping, pushing, leaping, and running through cones while maintaining their balance is a way to allow children to experiment different sensory processes, while learning how their bodies work and developing a sense of body and self-control (Mauro & Cermak, 2006). Recently, researchers have established that physical

activity is particularly beneficial for children with ASD because it improves attention span during academic tasks, and reduces disruptive and off task behaviors that may cause class disruption (Magnusson, Cobham, McLeod, 2012; Menear & Neumeier, 2015; Todd, Reid, & Butler-Kisber, 2010; Watters & Watters, 1980). Additionally, circuit training promotes physical activity through moderate to vigorous exercises that are performed sequentially.

## Literature Review

### Benefits of Circuit Training for Children With ASD

Circuit training offers children with ASD the opportunity to be involved in an individualized or small group exercise program and receive the health benefits associated with regular physical activity. Children with ASD may have delays in motor development (Zachor & Merrick, 2012). Circuit training can be designed specifically to meet the needs of each child by incorporating exercises and activities where children can have success. Teachers can increase participation, and motivate children by frequently changing activities, having different stations, and transitioning quickly for students who have a short attention span (Crollick, Mancil, & Stopka, 2006). Further, developing activities with a sensorimotor approach for children with ASD can improve their sensory dysfunction, coordination, and motor control (Crollick, Mancil, & Stopka, 2006). For children with ASD, improving cardiovascular endurance and flexibility are both necessary for proper movement, and motor development (Crollick, Mancil, & Stopka, 2006). For these reasons, circuit training can be used as an alternative method to improve

the physical activity levels of children with ASD, while also improving aerobic capacity, health, and motor skills.

Circuit training has gained popularity because it is time-efficient, promotes healthy results, and does not require any one specific set of equipment (Lee, Spector, & Reilly, 2017). Several studies done on the effects of High Intensity Interval Training (HIIT) have proven that short exercises at high intensity can be a method to significantly increase and improve aerobic, strength, and cardiorespiratory fitness in athletes and untrained people (Androulakis-Korakakis et al., 2018; Lee et al., 2017). In addition, a study on the effects of 4-week HIIT program for obese children, reported that the participants found the HIIT program more enjoyable, and preferred compared to other types of workouts (Lee et al., 2017).

#### Research that has Changed Behaviors for Children With ASD

Physical activity has benefits that go far beyond physical changes. Researchers have shown that physical activity (i.e., moderate-to-vigorous) can improve on-task behaviors, overall health, and a decrease stereotypical and repetitive movements (Lang et al., 2010; Levinson & Reid, 1993; Magnusson, Cobham, & McLeod, 2012) for children with ASD. Various studies, such as Magnusson, Cobham, & McLeod, (2012), Todd and Reid, (2006), Watters and Watters, (1980) have demonstrated that moderate to vigorous exercise had positive effects on behaviors for children with ASD. Although, each study focuses on a distinct exercise, the common factor in all three is the intensity level (i.e., moderate-to-vigorous) that produces better on-task behavior. In addition, Levinson and

Reid, (1993) focused on the effect of exercise intensity on the stereotypic behaviors of individuals with autism indicated that all three participants (i.e., two males, one female, 11 years of age) had a decrease in stereotypic behaviors after 15 minutes of brisk jogging. Similarly, the *Journal of Physical Education, Recreation and Dance* promotes physical activity for children with ASD because of the benefits it has on this population, such as biological benefits (i.e., cognitive performance), behavioral benefits, and improvements in attention span (Menear & Neumeier, 2015). To sum it up, rhythmic activity that uses large muscles and are continuous including running or cycling at a moderate or vigorous level helps decrease inappropriate actions (Crollick, Mancil, & Stopka, 2006).

In all, any physical activity is beneficial for children with or without disabilities. The aim of this study is to reduce off-task behavior while promoting physical activity through circuit training that is high intensity, but short duration to engage children with ASD to participate. Activities that require social understanding, and communication can be a challenge for children with ASD, and as a result discourage them from participating in organized team sports (Menear & Neumeier, 2015). Therefore, this study will attempt to decrease off-task behaviors, for children with ASD through circuit training program that incorporates full-body movement. The researcher has hypothesized that the total number of off-task behaviors will decrease for each participant in the classroom following the circuit training exercise program.

### Purpose Statement

This study will attempt to decrease off-task behaviors, for children with ASD through circuit training program that incorporates full-body movement.

### Research Hypothesis

The researcher has hypothesized that the total number of off-task behaviors will decrease for each participant in the classroom following the circuit training exercise program.

### Keywords

*Autism Spectrum Disorders* - ASD is a neurodevelopmental disorder that acts as an umbrella term for children who are diagnosed with four separate disorders, including Autism, Asperger's syndrome, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified (American Psychiatric Association [APA], 2013).

*Circuit Training* - Circuit training is a program of mixed resistance, aerobic and flexibility exercises performed in sequence at a series of stations and can benefit children with ASD in both aerobic and anaerobic capacity (Quinn, 2018).

*Exercise* - Exercise can be defined as a subcategory of physical activity, which is planned, structured, repetitive, and has a purpose of improving or maintaining physical fitness (Caspersen et al., 1985).

*Off-task behaviors* – For this study off-task behaviors refers to actions that are disruptive in the classroom such as talking out loud, not following directions, and not

keeping one's hands to themselves.

*Motor Development* - Refers to the continuous, age-related process of change in movement as well as interacting constraints (or factors) in the individual, environment, and task that drive these changes (Haywood & Getchell, 2014).



## CHAPTER II

### Method

#### Participants

For this study, two males both 15 years of age were recruited from a high school in Northern California to participate in the study. Each participant had been previously diagnosed with ASD Level 2 according to the Diagnostic and Statistical Manual of Mental Disorders (APA, 2013). Participants were recruited with the help of their primary high school teacher, primary researcher, and qualified for the study by showing signs of off-task behavior in class (e.g. disruptive, not-following instructions, non-participating). Each participant demonstrated the ability to understand verbal commands, engage in exercise, and not need consistent support from another educator. Prior to data collection, the primary researcher received Institutional Review Board (IRB) approval from Humboldt State University to move forward with the study. Additionally, each participant had parental consent and gave verbal assent to the primary researcher to be included in the investigation.

#### Instrument

The instrument used for this study was a behavior chart obtained from a middle school in Northern California. The behavior chart tracked student behaviors by tallying the number of times the participant was off task such as hands to self, quiet voice, and the ability to follow directions. For example, a tally would be marked in the quiet voice

column if the participant yelled or disrupted the class during the half hour the researcher was observing. Each participant was tracked on an independent behavior chart, and the tally marks were summed up after each observation. Student's off-task behavior was tracked using the instrument during all phases of the study (i.e., baseline phase 1, Intervention phase, and baseline phase 2). The primary researcher used the instrument before applying the intervention for baseline phase 1, again after each session (i.e., intervention phase) to determine if there was a decrease in the total number of off task behaviors, and during baseline phase 2. Also, the instrument had a column to write comments and notes on the off task behaviors displayed by the participants.

### Setting

The primary researcher observed the participants in their classroom during baseline phase 1, after the intervention phase, and baseline phase 2. Each session in the intervention phase took place on school campus in a large open play area with enough room for the exercises to take place. Within this play area there are multiple basketball courts, and the lines were used as starting points and end points. The black top was beneficial because it is a flat surface and students were able to run and jump on a leveled plain. Both participants are familiar with this area located next to their primary classroom.

### Procedures

All sessions took place on Tuesday, Wednesday, and Thursday, with each treatment session during intervention phase lasting a total of 33 minutes. Data collection

during baseline phase 1 began the first week of the study to obtain a baseline for each participant. The primary researcher observed each participant during baseline phase 1 in an academic class period. The following paragraphs describe the procedures the primary researcher used during the study.

### Baseline phase 1

The primary researcher observed the participants a total of four days for thirty minutes each day to establish a trend in behavior from each participant. After the four days a trend of an off-task behavior the participants consistently do, such as talking out of turn or not following directions was established. All data collected on off task behaviors was recorded by the primary researcher and tracked using the behavior chart instrument. After each participant demonstrated a trend in behaviors, the primary researcher moved participants into the intervention phase.

### Intervention phase

Following the baseline, participants engaged in three sessions of circuit-training program that consisted of various exercises performed at a moderate to vigorous level. Each lesson was comprised of a warm-up routine, agility drill, and agility combined with a skill (i.e., cup stacking, bean bag relay, throwing and catching football). Intervention phase one had a total of 3 sessions for approximately 33 minutes each session. The primary researcher set up the session before gathering the participants and coached the participants through every portion of the circuit-training program (i.e., warm-up, agility drills, agility with a skill) throughout the intervention phase.

### Baseline phase 2

Baseline phase two consisted of following the same steps as baseline phase one. The intervention (circuit training) was taken away, and the primary researcher observed the participants in their classroom for three days and tracked their off-task behaviors for thirty minutes each day. Again, the primary researcher used the instrument (i.e., behavior chart) to collect data and compare the total average of off-task behaviors in each phase.

Table 1. *Procedures for each Phase of Study*

Baseline Phase 1	Intervention Phase	Baseline Phase 2
<ul style="list-style-type: none"> <li>· The primary researcher observed the participants for four days for 30 minutes each day to establish a trend in behavior from each participant.</li> <li>· Participants baseline was measured through the behavior chart and completed before applying the intervention. (i.e., circuit training).</li> </ul>	<ul style="list-style-type: none"> <li>· Following the baseline, participants engaged in three sessions (i.e., 33 minutes each session) of circuit training that consisted of various exercises performed at a moderate to vigorous level.</li> <li>· Each lesson consisted of a warm-up routine, agility drill, and agility combined with a skill (i.e., catching, throwing, kicking).</li> </ul>	<ul style="list-style-type: none"> <li>· After taking away the intervention, the primary researcher observed the participants again for three days for 30 minutes each day to establish a trend in behavior.</li> <li>· Participants baseline was measured through the behavior chart.</li> </ul>

### Circuit Training Design

Participation in this circuit-training program required participants to engage in agility and the manipulation of objects. Every exercise was intended to get participants active, while developing motor skills and self-regulation. Each treatment session consisted of three 11 min segments (i.e., warm-up, agility, agility with a skill) for a total

duration of 33 minutes and two minutes for water breaks after the warm-up and agility exercises. During the warm-up, participants began with moderate intensity exercise (i.e., skipping, galloping,) and then finished with moderate to vigorous intensity exercises (i.e., agility ladders, running over hurdles,) for the remainder of each session. Each session began with a warm-up routine, which included two cones placed 10 yards apart, and participants would line-up behind one cone and follow the progression of walking on toes, walking on heels, jogging, skipping, side shuffling, hopping, galloping, leaping, and running fast for a total of eleven minutes. All sessions followed the same warm-up.

Following the warm-up participants engaged in agility exercises that included hurdles, cones, rings, agility ladders, and agility poles for approximately 11 minutes. Each session included one or more of the agility equipment stated above. The purpose of the equipment was to improve agility and aerobic capacity, while targeting the proprioceptive and vestibular system. The participant's proprioceptive senses are stimulated through jumping and pushing off the ground to exert force forward, whereas the vestibular sense is stimulated when changing directions while moving quickly. For example, during the first session participants began with one hurdle placed 5 yards from the starting point, and each participant ran twice over the hurdle before adding an extra hurdle. After every two runs an additional hurdle was added for a total of four hurdles and increasing the distance to a total of twenty yards. For each exercise the primary researcher demonstrated and explained the exercise. Throughout exercises the researcher gave verbal prompting and encouragement to continue the exercise at moderate to vigorous intensity.

The last 11 minutes of each session was a combination of the agility workout of the day and a skill, such as picking up beanbags, and or throwing a football. In this section of the lesson participants worked on both fine and gross motor skills (e.g., locomotor, object control), while continuing the agility exercises. For instance, participants had to run and leap over hurdles (i.e., gross motor) and stack cups (i.e., fine motor). In addition, participants had the opportunity to work in small groups and participate in different relay races including collecting beanbags and jumping over hurdles for a distance of 20 feet and returning to the starting point. Each game was about two minutes long, and the rules changed throughout the game, such as picking up two bean bags, throwing bean bag back, and or having to get the farthest been bags first. In session two participants had to step in and out of hula-hoops that where placed on the ground. Similar to the first session, additional hula-hoops were added, and the distance increased. The hula-hoops were also placed in a zigzag formation, and hopscotch pattern. The last part of the session consisted of participants catching a football that is thrown to them, running through the hula-hoops with the football, and throwing the ball at a target (i.e., primary researcher) after running through the hula-hoops. A detailed day-by-day schedule of the 3-session circuit training is available in the appendices.

Table 2. *Description of Circuit Training Program Sequence and Activities*

Warm-up	Agility	Agility and Skill
<ul style="list-style-type: none"> <li>· Every session consisted of the same warm-up routine. Every movement pattern lasted approximately 1 minute:</li> <li>· Progression: walking on toes, walking on heels, jogging, skipping, side shuffling, hopping, galloping, leaping, and running fast.</li> </ul>	<ul style="list-style-type: none"> <li>· Following the warm up participants engaged in a variety of agility, speed, balance, and coordination exercises.</li> <li>· Agility exercises include;               <ul style="list-style-type: none"> <li>- 6 – 12-inch Hurdles</li> <li>- Speed ladder</li> <li>- Cones</li> <li>- Agility poles</li> <li>- Hula hoop rings</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>· Lastly agility and skill consisted of one or more of the agility exercises combined with a skill such as kicking or throwing.</li> <li>· Object Manipulation skills:               <ul style="list-style-type: none"> <li>- Throwing</li> <li>- Kicking</li> <li>- Shooting</li> <li>- Passing</li> <li>- Stacking cups (fine motor)</li> </ul> </li> </ul>

### Research Design

The design used for this study was a single-subject withdrawal design (i.e., A-B-A). A behavior chart to keep track of each participant's off-task behaviors in class was used for the baselines and following the intervention phase. The researcher collected data on each participant's total number of off-task behaviors to establish a trend within baseline 1. After developing a trend, the researcher moved into the intervention (i.e., circuit training program designed to keep participants moving at a moderate to vigorous intensity). The primary researcher recorded each participant's total number of off-task behaviors individually.

### Visual Analysis

Participants were observed and measured on their off-task behavior through primary researcher observation. The behavior chart was used to determine the baseline of each participant, and also after the intervention to compare the tally marks of off-task behaviors. The data results determined if there was a significant change in decreasing off-task behavior when applying the intervention. The primary teacher also had the opportunity to share her thoughts and comments on the participant's behavior before and after the intervention.

### Limitations

1. Behavior of the participants on any given day (i.e., on task, off task)
2. Students may decide not to participate and affect the results of the study.
3. Results of this study can't be generalized across the population of children with ASD.
4. Weather may discourage students to participate or give full effort (i.e., warm day).
5. Primary researcher tracks off task behavior (i.e., disrupting classroom).

### Delimitations

1. All children diagnosed with ASD
2. Age range of participants
3. Consistent location and time of study each day
4. Consistency of instruction Chapter



## CHAPTER III

### Individual Results

The purpose of this study was to determine if a circuit-training program would decrease the total number of off-task behaviors for children with ASD. Researchers have demonstrated that moderate to vigorous physical activity (i.e., jogging for 15 min) has positive effects on behaviors such as reducing stereotypic behaviors and self-stimulatory behaviors (Levinson and Reid, 1993; Watters & Watters, 1980). For this study, participants were encouraged by the primary researcher to engage in the circuit-training program. The circuit-training program consisted of several sessions, consisting of three phases, including a warm up (i.e., move patterns), agility exercises (i.e., speed ladder, agility cones, hurdles), and agility and a skill exercises (i.e., bean bag relay, stacking cups, kicking). During Baseline Phase 1 and 2 the primary researcher observed both participants in the classroom setting for 30 minutes each day and recorded the total number of off-task behaviors (e.g., hands to self, quiet voice, and following instructions) for each participant. Within the intervention phase the primary researcher observed the participants immediately following the intervention (i.e., circuit training) to record total number of off-task behaviors. A detailed description of the results is included in the following sections: (a) Participant Demographics (b) Individual results and (c) Summary.

#### Participant Demographics

The two participants for this study were 15 years of age, diagnosed with ASD,

and attended the same high school in northern California. Prior to the study, both participants demonstrated off-task behaviors in the classroom and were chosen to participate based on the feedback provided by their primary teacher and observations by the primary researcher prior to the study beginning.

### Participant 1

Participant 1 was a 15-year old male in 9<sup>th</sup> grade diagnosed with ASD (i.e., Level 2). Participant 1 was chosen for this study by his primary teacher and primary researcher due to his high number of off-task behaviors exhibited within the classroom (i.e., blurting out, not following instructions, not keeping his hands to himself). Participant 1 needs substantial support (i.e., teacher checking in on him frequently, taking breaks if needed, assistance from aid when assigned class work) throughout the day.

Baseline phase 1. During Baseline Phase 1 the primary researcher observed participant 1 for four days. Participant 1 demonstrated defiance the first day, but more than anything he would speak out loud and not follow directions. In total, participant 1 demonstrated six off-task behaviors on day one of Baseline Phase 1. In total, participant 1 demonstrated an average of 4.75 off task behaviors per day

Intervention phase. Within the Intervention Phase the researcher observed an immediate decrease (i.e., no off-task behaviors for day one) in the total number of off-task behaviors for participant 1. In treatment day two and three of the intervention Phase participant 1 demonstrated three and four off-task behaviors. Overall, for the Intervention Phase participant 1 demonstrated on average a total of 2.3 off-task behaviors per day. It

should be noted that the off-task behaviors increased 15 minutes after returning from the circuit training programs.

Baseline phase 2. Participant 1 demonstrated three off-task behaviors on day one. On day two, participant 1 demonstrated four off-task behaviors. On day three, participant 1 demonstrated six off-task behaviors. Altogether, participant 1 demonstrated on average a total of 4.3 off-task behaviors per day

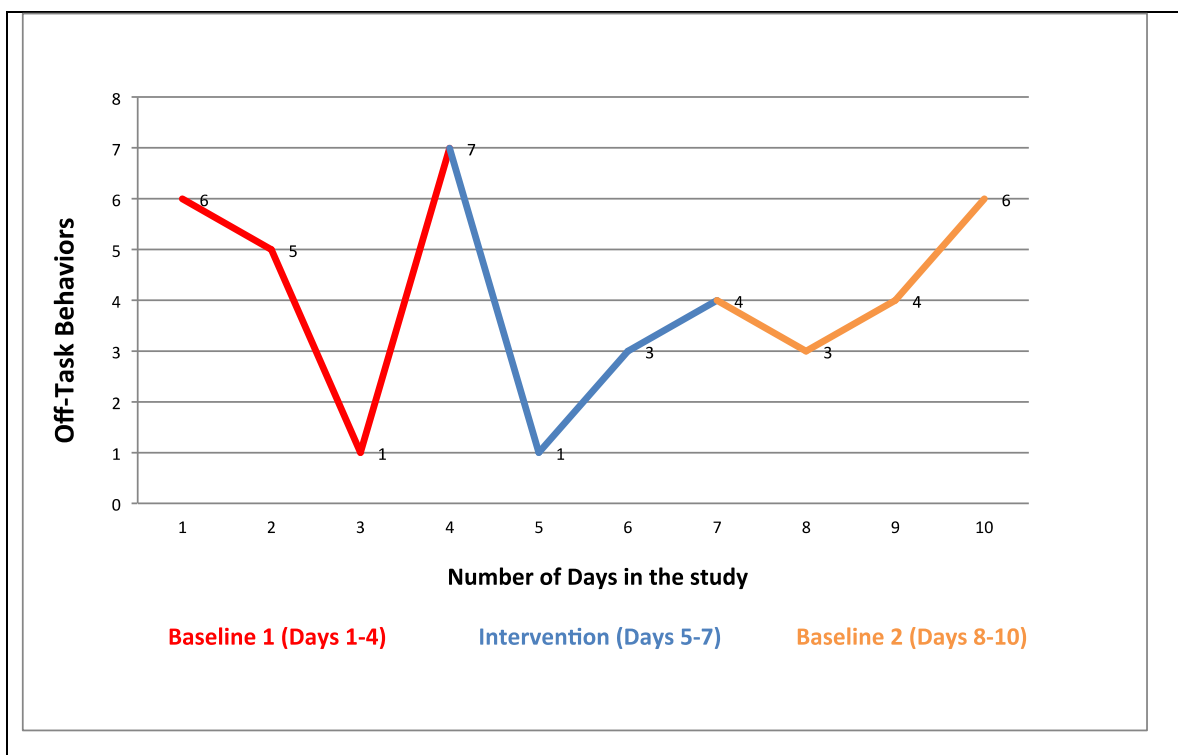


Figure 1. Participant 1: Total Number of Off-Task Behaviors Demonstrated Within Each Phase

## Participant 2

Participant 2 was a 15-year old male in the 10<sup>th</sup> grade diagnosed with ASD (i.e., Level 2). He was chosen for this study due to his high numbers of off-task behaviors displayed in the classroom (i.e., blurting out, not following instructions) by his primary teacher and primary researcher. In addition, he demonstrated stereotypical behaviors (i.e., rocking, waving hands in his face) during class. He is currently diagnosed at level 2 and requires substantial support.

Baseline phase 1. For Baseline Phase 1, participant 2 was observed for 30 minutes each day. Participant 2 demonstrated six off-task behaviors on day one. On day two participant 2 demonstrated seven off-task behaviors. On day three, participant 2 demonstrated five off-task behaviors. On day four, participant 2 demonstrated eight off-task behaviors. Participant 2 averaged a total of 5.75 off task behaviors within Baseline Phase 1.

Intervention phase. Within the intervention phase, participant 2 demonstrated four off-task behaviors on day one. On day two of intervention phase, participant 2 did not demonstrate any off-task behaviors. On day 3, participant 2 demonstrated three off-task behaviors. Overall, participant 2 demonstrated an average of 2.3 off-task behaviors during the intervention phase.

Baseline phase 2. Due to the participants' absences throughout Baseline Phase 2 the researcher was only able to observe the participant for one day. During that day participant 2 demonstrated a total of four off-task behaviors.

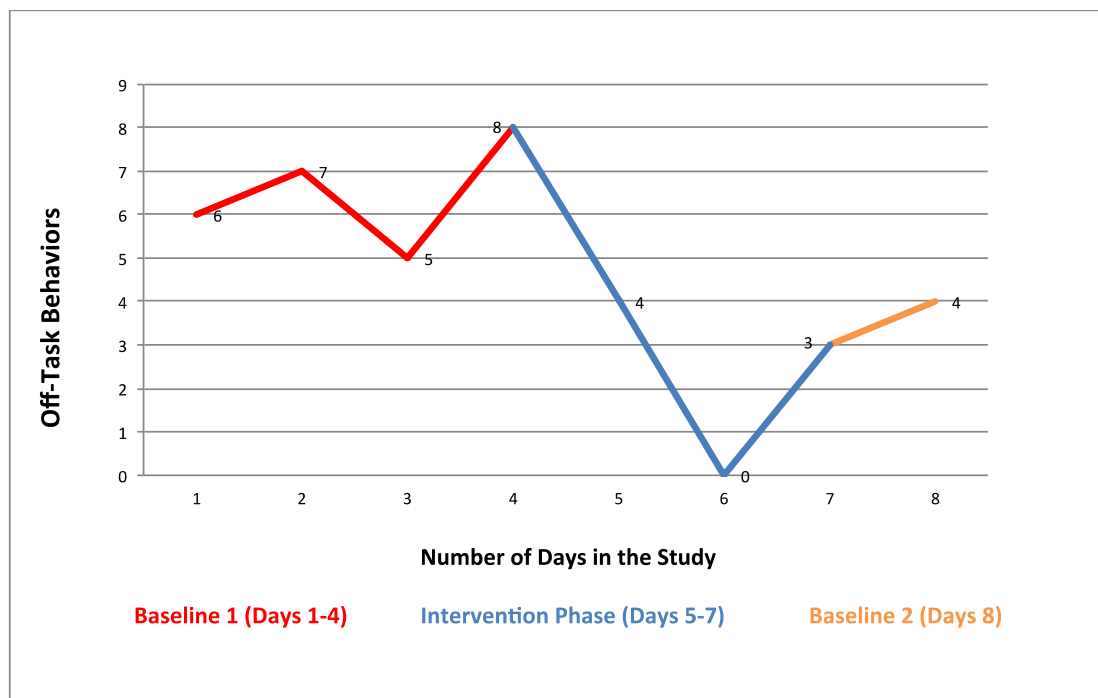


Figure 2. Participant 2: Total Number of Off-Task Behaviors Demonstrated Within Each Phase

### Summary

The results from this study demonstrate that the circuit-training program had positive effect on decreasing the average number of off-task behaviors for each participant during the intervention phase. Both participants demonstrated a higher average of off-task behaviors prior to the intervention being introduced and after the intervention was withdrawn. It should be noted that due to behavior issues and poor attendance the researcher was not able to complete the originally designed withdrawal study where each participant would be re-introduced to the intervention phase following Baseline Phase 2. These results will be further discussed in the following chapter.

## CHAPTER IV

### Discussion

The purpose of this study was to determine if a circuit-training program could decrease the total number of off-task behaviors for children with ASD. The two participants in the study were diagnosed with ASD (i.e., Level 2) and were chosen due to their constant off-task behaviors in the classroom (i.e., stereotypical behaviors, blurting out, and not following instructions). Within the Intervention Phase of this study participants engaged in a circuit training exercise program for a total of three days to determine if this type of exercise program would decrease the total number of off-task behaviors exhibited within the academic period. Researchers have demonstrated that moderate to vigorous exercise reduces negative behaviors, decreases stereotypic behaviors, and increases self-regulation for children with ASD ((Magnusson et al., n.d.)Levinson & Reid, 1993; Magnusson et al., 2012; Todd et al., 2010). The researcher believed that by providing an exercise program he would be able to observe similar results within the participants. This study continued to provide support for past research demonstrating the efficacy of exercise for this population. However, without a large sample and small duration of data collected the researcher understands that a generalization on the relationship between the circuit-training program is not possible.

Unfortunately, the intended research design (i.e., A-B-A-B with-drawl design) was not followed through due to the participant's absences and time constraints. The intended Intervention Phase 2 was not reintroduced, and participant 2 data was only

collected one day during Baseline Phase 2. In addition, the participant's behavior was impacted by the lesson or activity of the day provided by their primary teacher during researcher observation in Baseline Phase 1 and 2. For example, participant 1 displayed three off-task behaviors during day one of Baseline Phase 2, but engaged in physical movement (i.e., dance syllables YouTube video) for the first 8 minutes of class, which may have had an impact on his behavior. Also, in day three of Baseline Phase 1 participant 1 was instructed by his primary teacher to sit next to an aid because of his behavior, and only tallied one off-task behavior within a half-hour. In general, participant 1 and participant 2 displayed none or few off-task behaviors during the first 15 minutes following the intervention phase. In addition, the primary teacher mentioned that participant 2 responded thoughtfully and accurately when answering questions to a class assignment following day one of the intervention.

### Conclusion

The findings of this study continued to demonstrate that exercise (i.e., circuit training program) has a positive impact on the lives of children with ASD. However, this study did have limitations including number of treatment days within each phase, only primary researcher tracking off-task behaviors, total duration of study, lack of inter observer agreement within each phase, sample size, as well as the researcher did not record the participants motivation levels of each day, and the heart rate. On one occasion, participant 2 demonstrated zero off-task behaviors during Intervention Phase day 2. This is believed to have occurred because the participant was provided the opportunity to

access an iPad for 25 minutes of the 30 minutes of observation. Results for Participant 1, were also believed to be impacted by the structure of his class following the Intervention Phase as his Para educator was placed next to him and therefore may have impacted the total number of off-task behaviors for that treatment day. Overall, both participants' attendance was not consistent and due to time constraints, the researcher was not able to continue the study. It should be noted that the researcher did observe both participants demonstrating a change in their behavior immediately following the Intervention Phase for approximately 15 minutes after the intervention. On one occasion the primary teacher noticed participant 2 responding to answers in a more thoughtful manner than usual. In all, due to these limitations the researcher believes the results with this study are not a complete representation of how exercise impacts the core behaviors associated with individuals with ASD.

#### Future Research and Recommendations

Although this study was useful to determine the effects of circuit training (i.e., exercise) on decreasing off-task behaviors, future studies should follow the intended research design (i.e., A-B-A-B) to confirm the impact of the intervention phases. In order to complete the experiment, the researcher should set aside a minimum of 12 weeks in order to complete the study. Several studies referenced in the literature review took a minimum of 9 to 16 weeks (e.g., Levinson & Reid, 1993; Todd et al., 2010), which allowed the researchers to gather enough data to demonstrate a functional relationship between the intervention and dependent variable of the study. Also, future researchers



should attempt to observe participants during an academic lesson in all phases of the study. The researcher should gather lesson plans from the primary teacher during the time he/she plans on observing the participants to observe them only in an academic setting, and also ask the primary teacher to avoid physical activity prior to baseline observations (Oriol, George, Peckus, & Semon, 2011). In addition, the researcher should plan to assign a teachers aid or someone other than the researcher to track the off task behaviors and avoid any bias data collection. Lastly, providing participants with an incentive or reward for participating at moderate to vigorous levels (i.e., edible reinforcements, prizes) may help to keep participants motivated to keep the same intensity throughout each session (Oriol et al., 2011). Overall, the main recommendation for future research is allocating extra time in case of unexpected circumstances such as participant absences.

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## APPENDIX

## Behavior Chart

Participant

	Hands To Self	Quite Voice	Follow Directions	Comments/ Number of Tally Marks
Baseline Phase 1				
Intervention Phase				
Baseline Phase 2				

## INFORMED CONSENT/Parent/Legal Guardian

### The effects of circuit training on decreasing off-task behaviors for children with Autism Spectrum Disorder

My name is Juan Carlos Hernandez and I am a graduate student at Humboldt State University and an Adapted Physical Education Instructor at Santa Rosa City Schools. I am conducting this research study to see if there are any effects of circuit training on decreasing off-task behaviors for children with Autism Spectrum Disorder. If your child volunteers to participate, your child will be participating in physical activity (circuit training) and be observed after each session to determine if there is any change in his behavior. Your child's participation in this study will last three weeks, and will take place during his allocated P.E. time for 33 minutes per session, and a total of 6 sessions.

Your child's participation in this study is voluntary. Your child has the right not to participate at all or to leave the study at any time without penalty or loss of P. E. time. The only possible risks involved for participants include tripping or falling. These risks are not expected, but can occur when running, jumping, and weaving through cones. There are some benefits to this research, particularly that participants will work on their coordination, agility, balance, and strength through circuit training while being active for 33 minutes each session.

If the participant decides to withdrawal from the research, the data collected will be removed from the study. No incentive will be provided for students to participate since it will take place during their allocated P.E. time.

It is anticipated that study results will be shared with the public through presentations and/or publications. Any information that is obtained in connection with this study and that can be identified with your child will remain confidential and will be disclosed only with your permission. Measures to insure your child's confidentiality are using last name only, and keeping data results stored in the researchers computer. Raw data containing information that can be identified with your child will be destroyed after a period of three months after study completion. The de-identified data will be maintained in a safe, locked location and may be used for future research studies or distributed to another investigator for future research studies without additional informed consent from you.

This consent form will be maintained in a safe, locked location and will be destroyed after a period of three years after the study is completed.

If you have any questions about the research at any time, please call or email me at (707)696-7757, [jchern19@gmail.com](mailto:jchern19@gmail.com) or advisor David Adams at [david.adams@humublodt.edu](mailto:david.adams@humublodt.edu). If you have any concerns with this study or questions

about your rights as a participant, contact the Institutional Review Board for the Protection of Human Subjects at [irb@humboldt.edu](mailto:irb@humboldt.edu) or (707) 826-5165.

Your signature below indicates that you have read and understand the information provided above, that you willingly agree to your child's participation, and that you may withdraw your consent at any time and discontinue your child's participation at any time without penalty or loss of benefits to which your child is otherwise entitled.

Signature Date \_\_\_\_\_



## Circuit Training Sessions

Warm Up	Agility	Agility and Skill
<p><u>Set up:</u> 2 cones at a distance of 10 yards, and student's will all line up behind one cone.</p> <p><u>Duration:</u> 11 minutes total (approximately 1 minute each exercise).</p> <p><u>Warm up:</u> Progression-walking on toes, walking on heels, jogging, skipping, side shuffling, hopping, galloping, leaping, and running fast.</p>	<p><u>Set up/equipment:</u> 2 cones, 1 set at the corner of the end line of a basketball court to begin, and the other at half court. Add hurdles in between cones: hurdles (6", 9", and 12" height).</p> <p><u>Duration:</u> 11 total (approximately 1 min each exercise)</p> <p><u>Agility/Circuit Training:</u>  <u>Each exercise 2X</u>            -Leap over 1- 6" hurdle            -Leap over 2-6" hurdles (5feet in between)            -Leap over 3 hurdles, 2-6" and 1-9".            (5feet in between)            -Leap over 4 hurdles            2-6" / 1-9"/1-12"            (5feet in between)</p> <p>-Place hurdles 2 feet apart, while keeping the cone at half line for participants to finish with a sprint.</p> <ul style="list-style-type: none"> <li>· Step in between hurdles with both feet (quickly) going forward</li> <li>· Step sideways facing to the right and leading with left foot.</li> <li>· Step sideways facing to the left and leading with right foot.</li> <li>· Both feet together hopping over each hurdle with only one bounce.</li> </ul>	<p><u>Set up/ equipment:</u> At least four hurdles of 6". Set up four cones (along the end line of basketball court) and divide participants into four teams. Set up twenty been-bags 25 feet away (half court). Participants will leap over 1 or 2 hurdles as they run for a been-bag to the half court and back.</p> <p><u>Duration:</u> 11 minutes</p> <p><u>Agility and skill game:</u>  <u>Bean Bag relays</u>            Participants will have a relay race to see who can pick up the most been-bags. The rules will continue to change including: hopping over hurdles, must pick up the farthest bean bag, must throw the bean bag back your cone, must balance been bag on your head on your way back etc.</p>

Warm Up	Agility	Agility and Skill
<p><u>Set up:</u> 2 cones at a distance of 10 yards, and student's will all line up behind one cone.</p> <p><u>Time:</u> 11 minutes total (approximately 1 minute each exercise).</p> <p><u>Warm up:</u> Progression-walking on toes, walking on heels, jogging, skipping, side shuffling, hopping, galloping, leaping, and running fast.</p>	<p><u>Set up/equipment:</u> Hula Hoops, agility rings, and footballs. Basketball court sidelines, and end line will be used for students to circulate back into line.</p> <p><u>Time:</u> 11 minutes total (Approximately 1-2 minute each exercise).</p> <p><u>Agility/Circuit Training:</u> <u>Each exercise 2X</u></p> <ul style="list-style-type: none"> <li>- Place 5 hula hoops in a linear line and have students step in each Hula Hoop with both feet (quick feet).</li> <li>-Separate hula-hoops 1' foot apart and have students leap from hula-hoop to hula-hoop.</li> <li>-Have students jump with both feet together with hula-hoops 1' foot apart.</li> <li>-Use 12 agility rings and place them in a hop scotch pattern (1/2/1/2)</li> <li>-Use the same rings, and set them in a zigzag formation and have participants place one foot in each ring as they move forward.</li> <li>- Same set up (Zigzag), and add two hurdles (6" inches height) following the rings.</li> </ul>	<p><u>Set up/equipment:</u> Create two lines with same agility exercised practiced (hula-hoops, agility rings, and hurdles)</p> <p><u>Time:</u> 11 minutes total</p> <p><u>Agility and skill/game:</u> <u>throwing and catching</u></p> <ul style="list-style-type: none"> <li>-Have a thrower at the end of each line (teacher/helper) and throw a soft football to first person in line to run through hula-hoops, rings, and hurdles. Teacher/aid can decrease the distance of the throw in order for student to have success.</li> <li>-Have students catch the ball run through the hula-hoops, rings, and hurdles and then throw football to a target (cone/hula hoop/person).</li> </ul>

Warm Up	Agility	Agility and Skill
<p><u>Set up:</u> 2 cones at a distance of 10 yards, and student's will all line up behind one cone.</p> <p><u>Time:</u> 11 minutes total (approximately 1 minute each exercise).</p> <p><u>Warm up:</u> Progression-walking on toes, walking on heels, jogging, skipping, side shuffling, hopping, galloping, leaping, and running fast.</p>	<p><u>Set up/equipment:</u> Basketball sidelines and end line used for participants to line up and circulate around half court to get back in line. An agility ladder and cones will be used for this exercise.</p> <p><u>Time:</u> 11 minutes total (approximately 1 minute each exercise).</p> <p><u>Agility/Circuit Training:</u> <u>Each exercise 2X</u> -Agility Ladder (quick feet) -Agility Ladder (quick feet facing to the right) -Agility Ladder (quick feet facing to the left) -Agility Ladder (jumping both feet together) -Agility Ladder (hop scotch) -Agility Ladder (hopping right foot/left foot)</p> <p>-Place 4 cones five feet apart and have participants flip them upside down, and the next one in line right side up. - Weave through the 4 cones that are set five feet apart.</p>	<p><u>Set up/equipment:</u> Will need stacking cups, 2 agility ladders and cones. Use end line of basketball court as starting point. Set two teams on end line and 2 stacks of three cups for each team placed at half line.</p> <p>Time: 11 minutes total</p> <p><u>Agility and skill/game:</u> <u>Stacking cups</u></p> <p>-Have participants run through the ladder (name one of the agility exercise practiced) and stack up or down the cups. Relay race (each player must run through 3 times).</p> <p>-Add 4 cones and have participants weave through and stack up or down the cups. Each participant must run through 3 times and take a seat.</p>