

INCREASING THE DURATION OF TREADMILL WALKING TO REACH
MODERATE INTENSITY LEVELS FOR 2
STUDENTS WITH AUTISM SPECTRUM DISORDER (ASD)

By

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A Thesis Presented to

The Faculty of California State Polytechnic University, Humboldt

In Partial Fulfillment of the Requirements for the Degree

Master of Science in Kinesiology

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July 2023

ABSTRACT

INCREASING THE DURATION OF TREADMILL WALKING TO REACH MODERATE INTENSITY LEVELS FOR 2 STUDENTS WITH AUTISM SPECTRUM DISORDER (ASD).

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This study aims to increase the duration of treadmill walking to reach moderate intensity levels for 2 students with autism spectrum disorder (ASD). The researcher incorporated a token-economy board that was used to indicate total time walking and walking goals. A single case changing-criterion design was used in this study and consisted of a baseline, multiple sub-criteria intervention phase, and a follow-up phase. Results showed that there was a positive relationship between the intervention and the total walking time for each participant. Each participant met the criterion for each phase, eventually leading to meeting their overall goal for the study. Throughout the study Participant 2 reached moderate intensity levels 43.9% of the total time in the study. This study may be of importance to provide a reference for an intervention that may lead to a healthier lifestyle and changing behaviors for the participants with ASD.

Keywords: Autism spectrum disorder, Self-determination theory, physical activity, exercise

ACKNOWLEDGEMENTS

I would like to first thank Professor Dr. David Adams for supporting the development and guidance throughout the writing of this study. I would also like to acknowledge the committee Dr. Rock Braithwaite and Dr. Brian Blackburn for their constructive feedback that led to building a foundation for this study. I would like to give a special thanks to the participants and their families for being part of this study and dedicating their time to the development and completion of this study. I would also like to show my gratitude to my fellow researchers in this study Martin Calderon and Ruben Diaz for their continuous contribution and support throughout the study.

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INTRODUCTION

Physical Activity/Exercise

The Centers for Disease Control and Prevention (CDC, 2022) recommends that children, including those with autism spectrum disorder (ASD) ages 6 to 17 years engage in 60 minutes or more of daily moderate-to-vigorous physical activity or exercise. Physical activity is defined as any bodily movement that is produced by the contraction of skeletal muscles that substantially increases energy expenditure and could include walking, running, or swimming (WHO, 2020). Exercise is a physical activity that is planned and structured and used to condition the body (e.g., walking, running, CDC, 2017). For individuals with ASD engaging in regular physical activity and/or exercise may be difficult due to existing barriers (e.g., parent perception; Huang et al., 2017; Must et al., 2015.). These barriers may have a negative impact on the individual's self-perception; thus leading to additional declines in physical activity (Must et al., 2015). The American Psychology Association (APA; 2022) defines self-perception as the view a person has of his/herself or any thoughts whether it defines the mental or physical attributes of themselves. Self-determination theory proposes that when autonomy, competence, and relatedness are achieved, self-perception will improve and may lead to an increase in physical activity and exercise (Thøgersen-Ntoumani & Ntoumanis, 2007).

Autism Spectrum Disorder

ASD is defined as a neurological and developmental disorder that affects both social and communication skills and produces restrictive and repetitive behaviors (National Institute of Health, 2022.). ASD is categorized into three levels (i.e., 1,2,3) based on the degree of support needed for the child to be successful within their normal day. Level 1 (requiring support) with no support in place the individual will demonstrate deficits in social communication and difficulty in response to social cues. Level 2 (requiring substantial support) with support in place the individual will demonstrate significant deficits in social communication, limited social interactions, and abnormal response to social cues. Level 3 (requiring very substantial support) with support in place the individual will demonstrate extensive deficits in verbal and nonverbal social communication and social interactions as well as social overtures from others receive a minimal response. In all three levels there is difficulty with flexibility in changes, and in Levels 2 and 3 restricted/repetitive behaviors interfere with functioning in different varieties of contexts (APA, 2013). Current reports indicate that 1 in 100 children are being diagnosed with ASD. Within the United States, the prevalence rate is 1 in 36. (WHO, 2022; CDC, 2023). As early as 18 months children can be diagnosed with confidence (Hyman et al., 2020).

Benefits of Physical Activity for Students with ASD

Regular physical activity has general benefits that include reduced risk of high blood pressure, diabetes, colon cancer and physiological well-being (WHO, 2022). Physical activity is categorized into two different categories: moderate intensity (heart rate [HR] between 64% and 76% of maximum HR) and vigorous intensity (HR between 77% and 93% of maximum HR; NIH, 2014). It appears that vigorous-intensity physical activity for a minimum of 10 to 15 minutes in duration has been seen to be favorable in behavior change (Ahmadi et al., 2022). Specifically for individuals with ASD moderate to vigorous physical activity has been shown to have substantial benefits across the health domain and across the lifespan which included improvements in weight status, cardiovascular health, emotional health, and cognitive performance (Lang et al., 2010; Sowa and Muelenbroek, 2012; Tomporowski et al., 2011), as well as social skills (Sowa & Meulenbroek, 2012) and motivation (Bass et al., 2009).

Self-Determination Theory

Self-determination theory embeds three fundamental psychological human needs: autonomy, competence, and relatedness (Ryan & Deci, 2000; Ryan et al., 2023). When satisfying the three fundamental psychological human needs of SDT, researchers have demonstrated improved mental health (i.e., lower depression, anxiety, and higher quality of life) and physical health (Ryan et al., 2008; Williams & Deci, et al., 1998). Researchers have reported that SDT has established motivation-based foundations of

wellness and positive functioning in sports and exercise settings (Mossman et al., 2022; Teixeira et al., 2012). Physical activity can be intrinsically and extrinsically motivated (Ryan et al., 2009). For example, intrinsic motivation can be participating in an activity that brings enjoyment and personal excitement (Ryan et al., 2017). Conversely, extrinsic motivation occurs when the individual(s) participate in an activity for outcomes related to the activity for public recognition or awards (Teixeira et al., 2012). When applying SDT as a physical activity intervention, researchers have reported positive effects (Lock et al., 2018). Researchers have suggested SDT can be an effective approach to physical exercise motivational instinct amongst individuals with ASD with guidance (Todd 2007; Block et al., 2022).

Autonomy

Autonomy comes from within the context of a behavior that is within the self rather than being directed from external sources (Deci & Ryan, 2000; Ryan & Connell, 1989). The need for autonomy comes from the experience of being volitional and humans having the tendency to learn and to develop (Flavell, 1999). Autonomy and competence require satisfaction to enable intrinsic motivation that allows reflective self-endorsed choices (Niemiec & Ryan, 2009). For individuals with ASD, the opportunities to develop their own thoughts or complete activities on their own are limited due to a number of barriers (parent perception; Nichols et al., 2019). Additionally, there are a number of evidence-based practices that are developed around controlling the individuals' day-to-day activities (e.g., schedules, modeling, task analysis; National Professional

Development Center on ASD, 2015). When given the opportunity to provide perspective and volition researchers have reported improved satisfaction for individuals with ASD (Baard et al., 2004; Moreau & Mageau, 2012).

Competence

People seek competence to maintain and enhance skills through activities to continue challenging themselves to maintain optimality (Ryan & Deci, 2002). Although competence is not an attained skill or capability, it is a sense of confidence and effectance in their ability to perform (Reeve et al., 2004). It was found that both autonomy and competence had a positive and indirect effect on physical activity (Hamm & Yun, 2018). White et al. (2021) demonstrated that when individuals were provided the choice to determine their physical activity, feelings of competence and to function effectively were reported.

Relatedness

Relatedness is the sense of being somewhere the person can relate, have a sense of belonging, social connection, and having relationships with others (Baumeister & Leary, 1995). Individuals tend to have the tendency to connect with others and be accepted which is drawn from a concept of integrative tendency of life (Reeves, 2017). Although connections are very important, relatedness does not focus on the outcome or formal status, the concern is the importance of the psychological sense of secure communion or unity (Reeve et al., 2004). Individuals that have poor social engagements

often lead to low levels of physical activity (Pan, 2009). In order for individuals to be motivated in participating in physical activity, there has to be a connection to the social community and the activity itself (Deci & Ryan, 1991; Standage et al., 2003). The characteristics of social impairment and lack of social engagement for individuals with ASD may impact the relationships of initiating or sustaining relationships (Newsom et. al, 1982). There is another theory that has interventions to help with initiating and sustaining relationships. Contact theory proposes relationships between typical and non-typically developing individuals and if they have experiences that are complementary there will be a mutual positive attitude toward each other (DeAngelis, 2001; Mavropoulou & Sideridis, 2014). Therefore, the purpose of this study was to determine the impact of SDT and a token-economy board on the walking time of two students with ASD.

METHODS

Participants

Participants for this study will include two individuals with ASD 16 and 17 years of age. Participants will be recruited from Humboldt Fit where the three researchers had previously completed their student teaching in Northern California. Recruitment of participants consisted of speaking directly with each participant and receiving parental consent. Additionally, all participants' parents/caregivers indicated that their child had no previous injury that would impact their ability to participate in this study.

Setting

The study will take place in a student recreation center at a University in Northern California. The student recreation center is divided into two areas (open turf field, weight room). The open turf field will allow participants to warm-up, stretch, and for the researchers to communicate the established exercise goals for each day. The weight room consists of free-weights, weight machines, treadmills, stationary bicycles, elliptical machines, and other resources. All sessions will take place during open gym time during normal university hours.

Instrumentation

Heart-rate Monitors

The IHT zone wrist heart rate monitor will be used to track and determine heart rate (HR) levels (low intensity, moderate intensity, high intensity), as well as pre-HR, average HR, peak HR, and recovery HR. Pre-HR will be measured prior to each participant beginning walking exercise. Recovery heart rate will be assessed 2-minutes after the participant concludes the recovery walk. During treadmill walking time each participant's HR will be recorded at the end of each minute to assure that a moderate level (i.e., 64 - 74% of maximum HR) of intensity is met and continued throughout.

Treadmill

The treadmill used in this study is the Precor TRM 600 LINE. This treadmill has the ability to reach 12 mph and has 60 inches of running surface. It also can reach a 15% incline of elevation range to train going uphill. The treadmill does collect data itself; it records the amount of time a person is walking/running, distance, calories burned, and heart rate. There are three different ways the user may stop the treadmill, there is a red stop button that completely stops the treadmill, a string that is attached to the user that they can pull to stop the treadmill, or simply get off the treadmill and press the red stop button.

Walking Speed

The walking speeds were agreed on beforehand, during the warm-up the participants would walk at 2 mph for 1 minute. Once one minute has passed, the speed

would be increased to 3.2 mph or when the participant reached a moderate heart rate. The data collection would start once the warm-up was completed and the appropriate speed was applied.

Token Economy Board

A token-economy board will be used to indicate the total time walking and walking goal. The token board will be placed above the treadmill and the researchers will place an “X” on each minute after completion and circle the number once the participant has reached the established goal.

Performance Criteria

Each participant’s performance criteria for the duration of walking time was determined based upon the established walking duration goal by the participant(s) and the total time of the walking program (i.e., 6 weeks). For example, if a participant walked an average of 5 minutes within the baseline phase and then established a duration of walking goal totaling 20 minutes by the end of the 6-week program the participant performance criteria would be set at a 30% increase within each sub-phase to reach the goal duration of walking at the end of the 6-week program. Participants had to successfully meet the established performance criteria within each sub-phase in a minimum of 2 of the 3 consecutive sessions to progress to the next sub-phase.

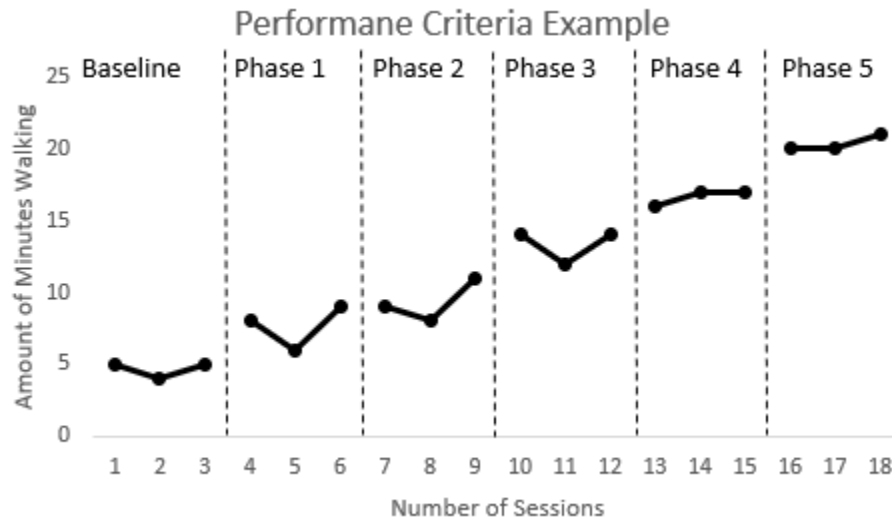


Figure 1. Changing Criteria Graph Example

Research Design

A single case changing-criterion design will be used in this study. The changing criterion design requires initial baseline observations on a single target behavior within baseline (Hartmann & Hall, 1976) and is then followed by a series of treatment phases using a stepwise criterion change for the target behavior within the intervention phase (Hall, 1971). Experimental control is established across phases as each phase provides a baseline for the following phase (Hartmann & Hall; Kazdin, 2016). Using the changing-criterion design will allow the researchers to evaluate the effectiveness of the designed program.

Structured Program

The structured program included a visually numbered token board indicating the agreed-upon total duration time for the session (e.g., 1-10). Numbers were marked over with an “X” each time that minute was completed, and the participant was on-task (e.g., continued walking with no request to stop). Increasing time intervals were included each new week in a stepwise fashion and were based on the total duration time listed as a goal for each participant.

Dependent Variables and Data Collection

Continuous data will be collected each session. Specifically, the researchers will record the total duration of walking time on the treadmill for each participant, as well as pre-HR, average HR, peak HR, and recovery HR (see Table 1) with the goal of maintaining a moderate intensity level.

Table 1. Heart Rate Intensity Data Collection Recording Sheet

Pre-Heart Rate	Average-Heart Rate	Peak-Heart Rate	Recovery-Heart Rate

Walking duration was measured by the total time the treadmill belt was moving.

Termination of walking time was completed by the participant requesting to stop the treadmill, releasing the stop switch, by stepping off the treadmill. Table 2 provides an illustration of the data collection sheet that will be used to track duration of walking time.

Table 2. Total Duration of Walking Time for Each Session

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Procedures

Prior to data collection, all participants provided written assent (Appendix A). Additionally, participant parents were provided with a description of the study, and time commitments and asked to provide written consent (Appendix B) for the child to begin the study. The parents were also asked to fill out a demographic survey (Appendix C) about the participant to give insight into the participant.

Baseline Phase

Baseline testing began with the researchers telling the participants “Time to exercise.” A 1-minute warmup on the treadmill began at 2 mph with a 1 percent incline. After 1-minute, the treadmill speed will be increased to a speed of 3.2 mph. No change in the incline will be made. Participants will be told to walk as long as they can. Participants will also be told to alert them if they want to stop, or by pulling the safety cord by stepping off the treadmill. No other instructions will be provided. Heart rate

measurements will be measured using the IHT HR monitors prior to beginning the treadmill walking (resting HR) and during the walking time (i.e., each minute).

Intervention Phase

Following baseline procedures for walking speed the participants began at 2 mph and were moved to 3.2 mph after a 1-min warm-up. Based on Pan et al. (2022) the following procedures were used within the intervention phase: (a) if the participant signals a verbal or nonverbal request to finish walking the instructor will ask the participant to continue, (b) if the participant continues to signal to be finished, then the instructor will stop the treadmill and record appropriate data, (c) if the participant shows motivation to continue the instructor will prompt the participant to continue at 3.2 mph, and (d) if the participant shows two signals of verbal or nonverbal to discontinue walking the instructor will stop the treadmill and record appropriate data.

Follow-up Phase

In conclusion of the study, participants will be asked to return and perform the baseline assessment after 6 weeks. In this phase, there will not be any intervention but will follow the procedure as the baseline phase. Heart rate monitors will be used to record HR for the first 2, 4, and 6 minutes of the assessment.

Data Analysis

Visual analysis of data will be used to determine the variability of data, the trend in data, the immediacy of the effect of the intervention, and overlapping data points across phases with the goal of establishing a functional relationship (Ledford & Gast,

2018). Parsonson and Baer (2015) stated visual analysis allows for independent analysis and interpretation of results.

Social Validity

Horner et al. (2005) identified social validity as a social measurement of importance, practicality, and meaningful use over time. Overall, social validity will be measured through the responses of the parents of each participant and all other stakeholders (e.g., director of student recreation).

RESULTS

Participant 1

Participant 1 is a 16-year-old Caucasian male who was diagnosed with autism spectrum disorder at the age of two years old. It was indicated by his parents that he is considered to need level two support, meaning the participant requires substantial support. Participant One is active every day of the week and expressed he has not participated in an exercise program before. Participant 1 in this study completed the Baseline Phase, Criterion Phase 1, Criterion Phase 2, and Criterion Phase 3. Below is a description of Participant's performance within each of those phases.

Baseline Phase

Total walking time for Participant 1 was evaluated over three separate days. On Day 1 of the Baseline Phase participant 1 walked for a total of 25 seconds. This was followed by 37 seconds on Day 2 and 27 seconds on Day 3. The mean average for the three days of Baseline was 29.7 seconds. During each of these walking times Participant 1 pulled the emergency stop cord connected to the treadmill to stop his walking. Participant 1 was asked on each occasion if he would like to continue walking by the primary researcher. Due to limited verbal expression, Participant 1 responded by leaving the treadmill area indicating that he no longer wanted to walk on the treadmill. After Baseline Phase, the participant was told his average time on the treadmill and due to his need of support he was guided by the primary researcher to make his decision of the

amount of time he wanted to be on the treadmill by the end of the study. Due to limited verbal expression the participant was given different options of time and the participant chose that he would like to be on the treadmill for 1 minute and 30 seconds by the end of the intervention.

Criterion Phase 1

In Criterion Phase 1 the set criterion goal was set at 45 seconds on the treadmill. On day 1 of Criterion Phase 1 the participant walked for 22 seconds, in the following two days the participant walked 46 seconds on day 2 and 45 seconds on day 3. Based on the performance criteria that the participant would need to perform at or above the criterion goal in 2 or the 3 treatment days the participant was able to meet the goal and move onto the next criterion phase.

Criterion Phase 2

The goal for Criterion Phase 2 was set at 60 seconds on the treadmill. The participant was able to walk for 60 seconds on day 1. This was followed by 63 seconds on day 2, and 53 seconds on day 3. Based on the performance criteria that the participant would need to perform at or above the criterion goal in 2 or the 3 treatment days the participant was able to complete the goal for criterion and move on to the next.

Criterion Phase 3

In Criterion Phase 3 the goal for the participant was set at 75 seconds on the treadmill. On day 1, 2, and 3 of Criterion Phase 3 the participant walked for 75 seconds on the treadmill. Based on the performance criteria that the participant would need to

perform at or above the criterion goal in 2 or the 3 treatment days the participant was able to meet the goal on each day and move onto the next phase.

Follow-up Phase

Participant 1 was evaluated 6 weeks after the initial study on their total time on the treadmill. Participant 1's total time on the treadmill was 37 seconds on the treadmill. In the Follow-up Phase the participant was given the opportunity to verbally indicate if he would like to discontinue or he also had the option to pull the emergency stop cord connected to the treadmill.

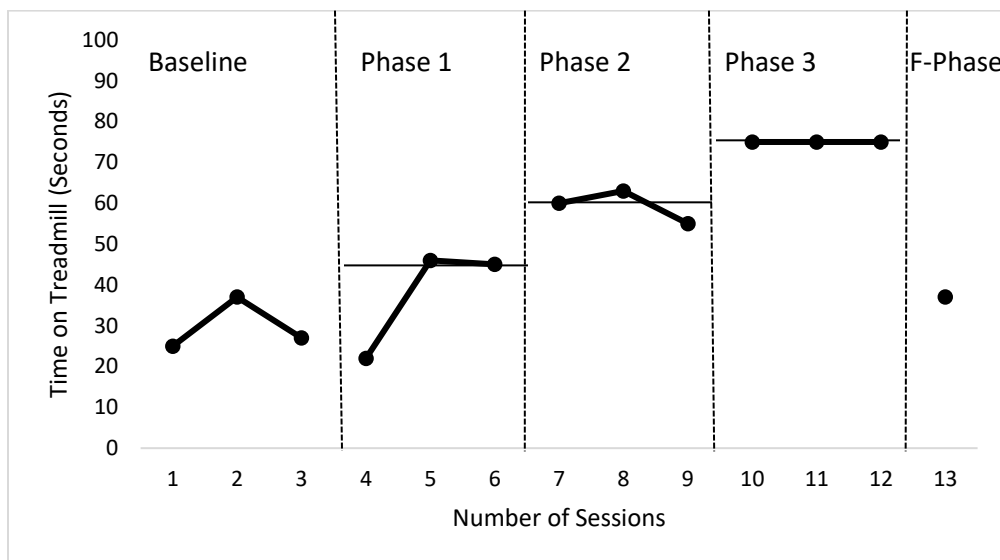


Figure 2. Total time walking on the treadmill for Participant 1 during Baseline, Intervention Phases, and Follow-up Phase

Note: F-Phase = Follow-up Phase

Participant 2

Participant 2 is a 17-year-old Caucasian male who was diagnosed with autism spectrum disorder at the age of 8 years of age. It was indicated by his parents that he is considered to need Level 2 support, meaning the participant requires substantial support. Participant 2 is active every day of the week and his parents have expressed he has not participated in an exercise program before.

Baseline Phase

Participant 2 was evaluated for total time walking on the treadmill within the Baseline Phase over 4 treatment days. On Day 1 the participant walked for 35 seconds. Day 2, Participant 2 walked for a total of 1 minute and 25 seconds. This was followed on

Day 3, where Participant 2 walked for a total of 2 minutes and 22 seconds, and Day 4, Participant 2 walked 1 minute and 19 seconds. The mean average for the 4 days of the Baseline Phase was 1 minute and 25 seconds. On each occasion the participant was given the opportunity to verbally indicate if he would like to discontinue or he also had the option to pull the emergency stop cord connected to the treadmill. The participant indicated that his goal by the end of the intervention would be to walk 15 minutes on the treadmill.

Criterion Phase 1

In Criterion Phase 1 the set criterion goal was set at 7 minutes on the treadmill. On day 1 of Criterion Phase 1 the participant walked for 7 minutes, in the following two days the participant walked 7 minutes and 8 seconds on day 2 and 7 minutes on day 3. Based on the performance criteria that the participant would need to perform at or above the criterion goal in 2 or the 3 treatment days the participant was able to meet the goal and move onto the next criterion phase.

Criterion Phase 2

In Criterion Phase 2 the set criterion goal was set at 10 minutes on the treadmill. On day 1 of Criterion Phase 1 the participant walked for 10 minutes and 4 seconds, in the following two days the participant walked 8 minutes and 40 seconds on day 2 and 10 minutes on day 3. Based on the performance criteria that the participant would need to perform at or above the criterion goal in 2 or the 3 treatment days the participant was able to meet the goal and move onto the next criterion phase.

Criterion Phase 3

In Criterion Phase 3 the set criterion goal was set at 13 minutes on the treadmill. On day 1 of Criterion Phase 1 the participant walked for 13 minutes and 4 seconds, in the following two days the participant walked 13 minutes and 2 seconds on day 2 and 13 minutes on day 3. Based on the performance criteria that the participant would need to perform at or above the criterion goal in 2 or the 3 treatment days the participant was able to meet the goal and move onto the next criterion phase.

Criterion Phase 4

In Criterion Phase 4 the set criterion goal was set at 15 minutes on the treadmill. On day 1 of Criterion Phase 1 the participant walked for 15 minutes, in the following two days the participant walked 10 minutes day 2 and 15 minutes on day 3. Based on the performance criteria that the participant would need to perform at or above the criterion goal in 2 or the 3 treatment days the participant was able to meet the goal.

Follow-up Phase

Participant 2 was evaluated 6 weeks after the initial study on their total time on the treadmill. Participant 2's total time on the treadmill was 5 minutes and 24 seconds on the treadmill. In the Follow-up Phase, the participant was given the opportunity to verbally indicate if he would like to discontinue or he also had the option to pull the emergency stop cord connected to the treadmill.

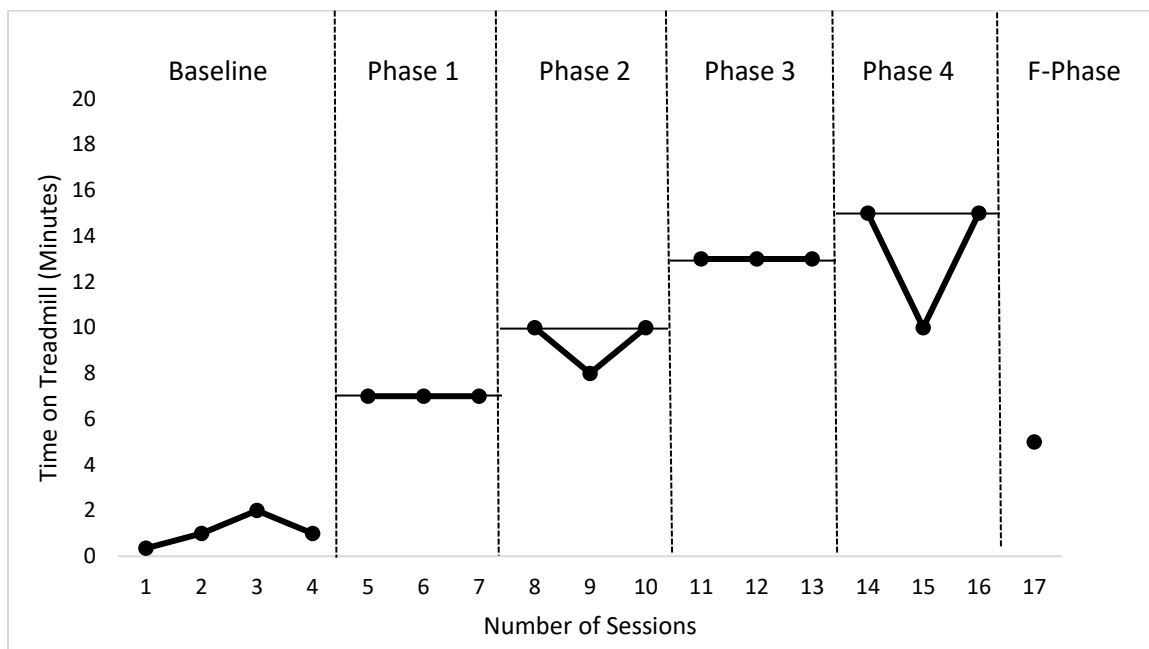


Figure 3. Total time walking on the treadmill for Participant 2 during Baseline, Intervention Phases, and Follow-up Phase

Note: F-Phase = Follow-up Phase

Table 3. Average Resting HR, Peak HR, and Moderate HR Level During the Baseline, Criterion, and Follow-Up Phases

	Resting HR	Peak HR	Min at Mod HR Level
Baseline	63.25	154.67	19.5/90 min (33.6%)
Criterion Phase 1	65	153.67	35.67/90 min (40.14%)
Criterion Phase 2	65.67	160.5	44.3/90 min (55.9%)
Criterion Phase 3	65	163.67	37.3/90 min (46%)

DISCUSSION

The study focused on increasing the duration of treadmill walking while reaching moderate intensity levels for 2 participants with ASD. In the study the researchers implemented a token-economy board that was used to indicate total walking time and their walking goals. A single case changing-criterion design was used in this study and consisted of a baseline, multiple sub-criteria intervention phase, and a follow-up phase. The results found within this study could be beneficial to provide reference of an intervention that has found positive results in changing behaviors for the participants with ASD.

This study explored the use of a structured reward system (i.e., token economy) which provides importance to meeting the goal of each criterion of each phase. In the structured reward system, researchers used a visual chart to show the amount of time the participants were on the treadmill. This visual chart aligns with strategies that are evidence-based practices for teaching individuals with ASD (Dillon et al., 2017; NPDC, 2017). When implementing the token economy, the researcher would express that they were circling the number and how much was left to achieve the goal. Each participant would focus and acknowledge that they have passed a portion of the criterion. A study that focused on walking time as the focused behavior same as this study, found that combining a structured program and a reward system that supported behaviors allowed participants to meet the targeted behaviors (Pan et al., 2022).

A single case changing-criterion design was used in this study to demonstrate the effectiveness of the walking program. Each individual participant was presented with the opportunity to have autonomy in their overall goal for the study. Participant 2 showed eagerness and self-determination in meeting his goal by showing commitment to the study. Participant 1 following this design had a mean average for the three days of Baseline phase of 29.7 seconds, and in the Follow-up phase he walked for 37 seconds. Although there was not significant improvement in his total time walking without intervention, the participant became more comfortable and had the ability to use the machine properly by the end of the study. Participant 2 had a mean average for the 4 days of the Baseline Phase of 1 minute and 25 seconds, and in the Follow-up phase he walked for 5 minutes and 24 seconds. Participant 2 increased almost 4 minutes from Baseline to Follow-up phase which was significantly more which researchers believe was result of the effectiveness of the walking program and the overall structure of the study.

Once Baseline Phase was completed, the participants were asked to provide autonomy in the development of their overall goal for the study. Adie et al. (2008) found when autonomy is met greater subjective vitality is present and when low levels of autonomy are present participants are subject to feeling emotionally and physically drained to participate. The participants were able to meet each criterion phase goal which ultimately led to meeting the overall goal set at the beginning of the study. In multiple studies, it was found that participants with ASD benefited from a structured training program which had positive results in the desired behaviors (Pitetti et al., 2007; Lochbaum & Crews, 2003; Yilmaz et al., 2004; Fragala-Pinkham et al., 2008). In the

study, the participants became more aware of their relatedness to the other adults in the recreation area. The participants began to interact more with other recreation area users and their motivation increased compared from the beginning of the study to the end (i.e., social skills, Sowa & Meulenbroek, 2012; i.e., motivation, Bass et al., 2009).

The implementation of SDT was focused to determine the relationship on physical activity as an intervention and the results of this study found a positive relationship (Lock et al., 2018). The structure of this program benefited the participants due to the guidance of the researchers found to be an effective approach to the participants that increased their motivational instinct (Todd 2007; Block et al., 2022). While increasing the time on the treadmill was the focused behavior and in the conclusion of the study finding success for both participants in meeting each criterion, Todd (2007) found similar success for individuals with ASD having positive outcomes while walking or jogging with the implementation of SDT.

LIMITATIONS

Limitations are present in this study; a main limitation was the number of participants that were present in the study. Due to the limited number of participants, the results are unable to be generalized across the population of people with ASD in this age range. The researchers were unable to have more participants due to the commitment of the number of treatments per week and travel requirements. Another limitation was the number of limited phases that were used in the study to show confidence that a functional relationship is present in the results that were obtained. It should be noted that in the original methods of the study, the researchers were looking for a 6-week intervention. Lastly, it should be noted that both participants were enrolled in their high school physical education classes while participating in this study which could have had a positive (increased walking time) or negative (fatigue) effect. Considering the limitations that were stated, the researchers believe that with the implementation of SDT and a token-economy board within a walking program, there can be increased walking time and changing behaviors for individuals with ASD.

Future research should explore having more participants with this study structure to help generalize the walking program for the targeted population. Due to ASD being a spectrum and having different levels of support when increasing the population of this study, it would be important to include different levels of support to show the strength across the 3 different levels of support. Another possibility to further the research would

be increasing the number of phases, increasing the number of phases would show the effects of that program using SDT and token economy in improving behaviors.

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APPENDICES

Appendix A: Assent Form

ASSENT TO PARTICIPATE IN A RESEARCH PROJECT:

Increasing the Duration of Treadmill Walking to Reach Moderate Intensity Levels for 3 Students with Autism Spectrum Disorder (ASD).

I am asking for you to agree to participate in a research project. This study is being conducted to determine the benefits of a 6-week walking program for individuals with an autism spectrum disorder. I am in charge of this research to decide if participants with autism spectrum disorder (ASD) can meet individual set exercise goals when following self-determination theory. You will also be asked to fill out a survey in respect of your own ability. This survey will be completed on the first day of the program.

The duration of this study is 6 weeks. Each week you will meet for 3 sessions, each session will be 1 hour and 30 minutes. This study will take place at Cal Poly Humboldt at their student recreation center. You will be asked to complete a survey on self-determination before and after the study.

I will not use any information that would allow others to know you were taking part in this study. You do not have to agree to participate in this study and can stop at any time. Your parents have given you permission, but you can still say "no". If you say "yes" and then change your mind or if something makes you upset, you can let your parents know. If you have questions, you can ask the researcher.

Would you like to be in this 6-week exercise program? If you agree to be a part of this study, please sign below.

Participant Signature

Date

Appendix B: Parental Consent Form

PARENTAL CONSENT FORM

Increasing the Duration of Treadmill Walking to Reach Moderate Intensity Levels for 3 Students with Autism Spectrum Disorder (ASD).

You are invited to participate in a research study. The researchers for this study are master students at Cal Poly Humboldt in the department of Kinesiology and Recreation Administration. This study is being conducted to determine the benefits of a 6-week walking program for individuals with autism spectrum disorder.

The participants will engage in a walking exercise program in the student recreation center at Cal Poly Humboldt. The results from this study will support the use of an evidence based practice to increase the walking duration for individuals with autism spectrum disorder. All participants will be asked to complete a survey which looks at how the individual is able to accomplish individual goals they have set for themselves prior to and after exercising. The parents/guardians participation in this study will be filling out a survey that includes demographics, personal information, and questions regarding the participant's self-determination.

Within this study each participant will work with the researcher at all times. The researcher will make sure that each participant will be shown how to properly use the treadmill during this study.

Your child's participation in this project is entirely voluntary. Even after you agree for your child to participate, you may decide to stop participation at any time without penalty or loss of benefits to which you or your child may otherwise be entitled. 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.

All data obtained from this study will be maintained in a safe, locked location, and will be destroyed 5 years after the study is completed. This consent form will be maintained in a locked location in the office of my advisor and will be destroyed 3 years after the study is completed. If you have any questions about the research at any time, please email Ruben Diaz (rgd19@humboldt.edu) Nicholas Velazquez (nv40@humboldt.edu), or Martin Calderon (mc146@humboldt.edu) or our advisor, Dr. David Adams at mc146@humboldt.edu.

If you have any concerns or questions about your rights as a participant, contact the Institutional Review Board for the Protection of Human Subjects at irb@humboldt.edu or (707) 826-5165.

Your signature below indicates that you have read and understand the information provided above, and that you willingly agree to your child's participation in this study.

Parents' Signature

Date

Appendix C: Demographic Survey

Demographics Questions:

1. Age of Participant: _____

2. Gender: **Male** | **Female**

3. Ethnicity:

- White
- Black or African-American
- American Indian or Alaskan Native
- Native Hawaiian or Other Pacific Islander
- Latino, Hispanic, or Spanish
- Asian or Asian-American
- Middle Eastern or North African
- Other: _____

4. At what age was your child diagnosed with autism spectrum disorder? _____

5. Looking at the descriptions below for levels of diagnosis of ASD, what level of support do you believe your child needs? (Circle one)

Level 1

Children with ASD level 1 experience some inflexible behavior, like difficulty switching between tasks, staying organized, and planning.

Level 2

Children with level 2 autism may have difficulty coping with changes in routine, which can cause challenging behavior.

Level 3

Children with level 3 autism exhibit marked inflexibility of behavior, with extreme difficulty coping with changes to routine. At this level, restrictive or repetitive behaviors interfere with the individual's ability to function. Changing focus from one activity to another may come with great difficulty and cause significant distress.

6. Are you currently involved in any physical exercise programs?

Yes | **No**

7. In general, at what age were your or your child's physical activity levels a concern? _____

Please mark the following box if your child's physical activity levels are not a concern

8. On average how often does your child exercise within a normal week?

- a. 0-1 days
- b. 1-2 days
- c. 3-4 days
- d. 5-6 days
- e. 7 days

9. What kind of physical activities do you enjoy participating in?

10. Have you or has your child participated in a weight training program?

Yes | No

If answered yes, how long was the program and where did the program take place?

Appendix D: Figures and Tables

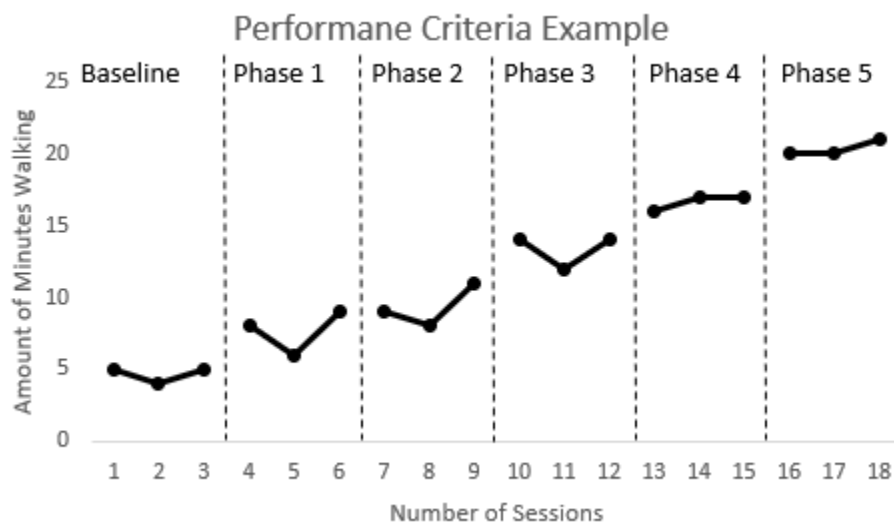


Figure 1. Changing Criteria Graph Example

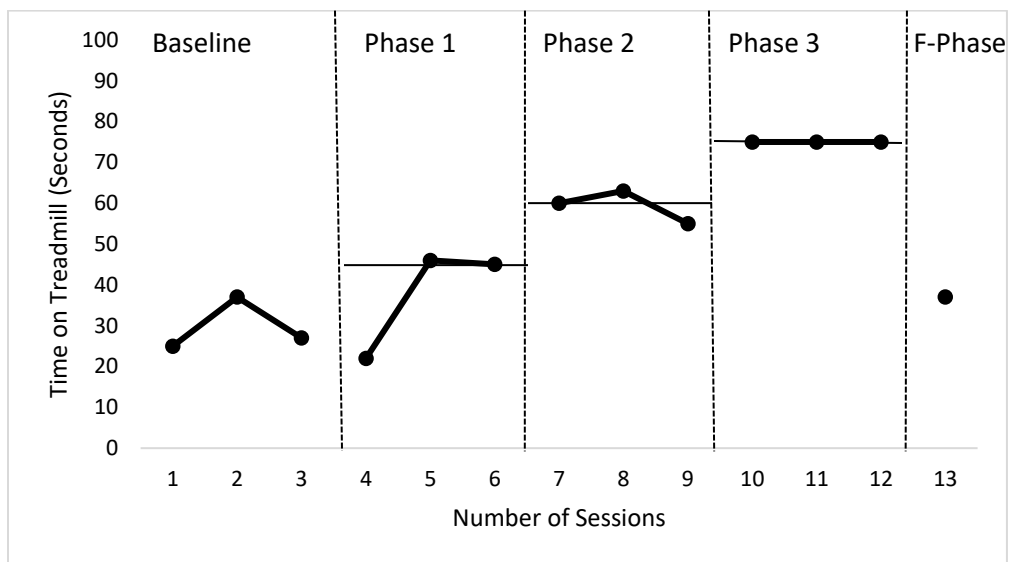


Figure 2. Total time walking on the treadmill for Participant 1 during Baseline, Intervention Phases, and Follow-up Phase

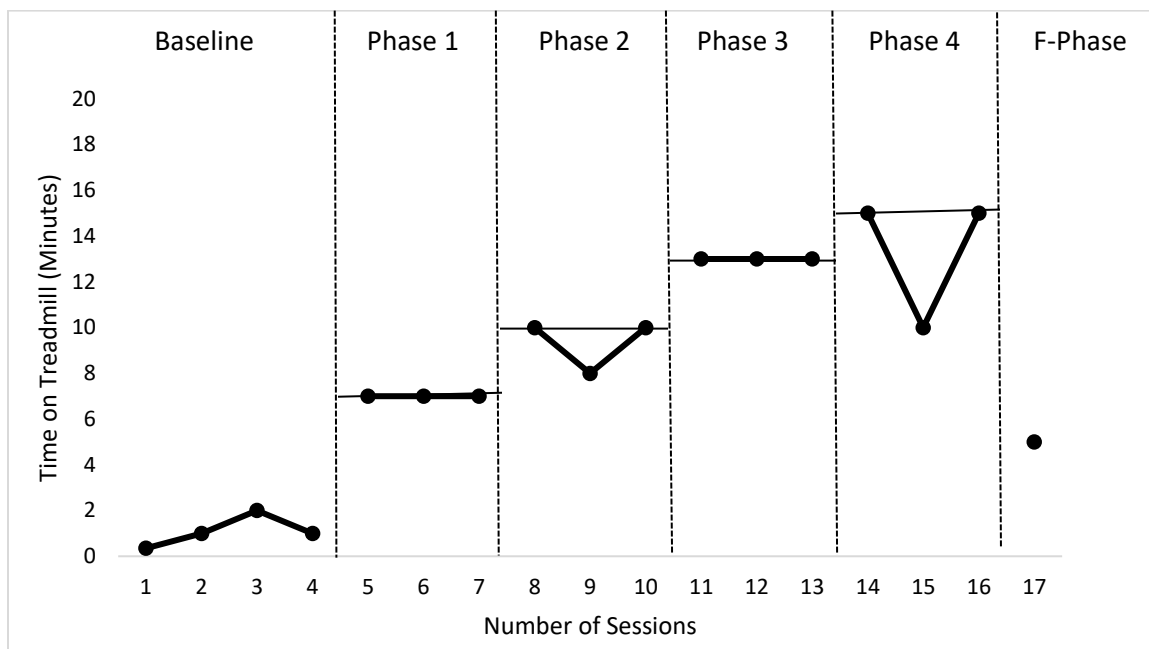


Figure 3. Total time walking on the treadmill for Participant 2 during Baseline, Intervention Phases, and Follow-up Phase

Pre-Heart Rate	Average-Heart Rate	Peak-Heart Rate	Recovery-Heart Rate

Table 1. Heart Rate Intensity Data Collection Recording Sheet

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Table 2. Total Duration of Walking Time for Each Session

	Resting HR	Peak HR	Min at Mod HR Level
Baseline	63.25	154.67	19.5/90 min (33.6%)
Criterion Phase 1	65	153.67	35.67/90 min (40.14%)
Criterion Phase 2	65.67	160.5	44.3/90 min (55.9%)
Criterion Phase 3	65	163.67	37.3/90 min (46%)

Table 3. Average Resting HR, Peak HR, and Moderate HR Level During the Baseline, Criterion, and Follow-Up Phases.