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INCREASING PHYSICAL ACTIVITY IN MIDDLE SCHOOLERS WITH INTELLECTUAL DISABILITY USING GOAL SETTING AND FITNESS TRACKERS

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THESIS

A thesis submitted in partial fulfillment
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ABSTRACT OF THESIS

INCREASING PHYSICAL ACTIVITY IN MIDDLE SCHOOLERS WITH INTELLECTUAL DISABILITY USING GOAL SETTING AND FITNESS TRACKERS

The purpose of the study was to evaluate the effects of goal setting and fitness trackers to increase daily step counts in adolescents with intellectual disability. An A-B-A-B withdrawal research design was implemented to evaluate the effectiveness of the intervention. The results indicated that goal setting and fitness trackers were effective in increasing daily step counts for two out of three participants.

KEYWORDS: Physical activity, fitness trackers, goal setting, learning and behavior disabilities, walking

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April 12, 2019

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Section 1: Introduction

Children and adolescents with disabilities are more likely to be overweight or obese than children and adolescents without disabilities (Rimmer,Yamaki, Davis, Wang, & Vogel, 2011) . Specifically, those with autism spectrum disorder (ASD; Curtin, Anderson, Must, & Bandini, 2010; Gillette et al., 2015), intellectual disability (ID; Krause, Ware, McPherson, Lennox, & Callaghan, 2016; Maïano, Hue, Morin, & Moullec, 2016; Sukanya, Small, & Baur, 2008), and other developmental disabilities (e.g., attention-deficit/hyperactivity disorder, learning disabilities; Phillips et al., 2014; Sukanya et al., 2008) are more likely to be overweight or obese than individuals without disabilities. Phillips et al. (2014) analyzed data from the National Survey of Children's Health report for 2011-2012 and found that 20.4% of adolescents with a developmental disability were considered obese in comparison to 13.1% of typically-developing adolescents. In addition, children with ASD tend to be less physically active than children without ASD (Gillette et al.; Pan, 2008; Sowa & Meuelenbroek, 2012). Similarly, adolescents with ID are less active than their typically-developing peers (Einarsson, Jóhannsson, Daly, & Arngrímsson, 2016; Einarsson, Ólafsson, Hinriksdóttir, Jóhannson, Daily, & Arngrímsson, 2014; Hinckson & Curtis, 2013) and often do not engage in the amount of recommended daily activity (Wouters, Evenhuis, & Hilgenkamp, 2018).

The Centers for Disease Control and Prevention (CDC; 2018b) recommends that adults get at least 150 min of moderate-intensity exercise (e.g., walking) or 75 min of vigorous-intensity aerobic exercise (e.g., running) per week. The CDC (2015b) also recommends that children and adolescents get at least 60 min of exercise per day. Of these 60 min, the majority of the exercise should be aerobic (e.g., walking, running). In a review of the physical activity literature, Tudor-Locke et al. (2011) found that getting 60 min of moderate- to vigorous-intensity exercise is often associated with achieving a total step count of 10,000-11,700 steps per day in adolescents.

There are many benefits to daily physical activity, including improved cardiovascular health, losing and maintaining weight, reduced risk of cardiovascular diseases, Type 2 diabetes, metabolic syndrome, and some forms of cancer, and increases in longevity (CDC, 2018c), mental health, and cognition (Sorensen & Zarrett, 2014). There are additional benefits for daily physical activity in children with ASD, including reduced stereotypy (Bahrami, Movahedi, Marandi, & Abedi, 2012), improved self-regulation (Allison, Basile, & MacDonald, 1991), and improved classroom performance, attention, and compliance (Reid, Factor, Freeman, & Sherman, 1988 as cited in Sorensen & Zarrett, 2014).

Additionally, physical activity can be used as an antecedent intervention for decreasing problem behavior (Allison et al., 1991; Cannella-Malone, Tullis, & Kazee, 2011; Lang et al., 2010). Antecedent interventions are implemented before the target behavior occurs in order to manipulate the establishing operation in an attempt to control behavior (Cooper, Heron, & Heward, 2007). In a systematic review of the literature, Lang et al. (2010) found that physical activity is an effective antecedent intervention for decreasing problem behavior and stereotypy, while also increasing appropriate behaviors, such as task engagement. Cannella-Malone et al. (2011) also found that systematically implementing exercise within the school day as an antecedent intervention led to decreases in problem behavior to zero or near-zero levels.

Common interventions for increasing physical activity are often treatment packages that consist of one or more of the following components. Goal setting has been utilized in a multitude of treatment packages (Hayes & Van Camp, 2015; Hustyi, Normand, & Larson, 2011; Kurti & Dallery, 2013; LaLonde, MacNeill, Eversole, Ragotzy, & Poling, 2014; Normand, 2008; Washington, Banna, & Gibson, 2014) and is the most commonly used component. Goal setting is when..., Positive reinforcement in the form of access to tangible items is the next most commonly used component of the treatment packages in the literature (Hayes & Van Camp, 2015; Hustyi et al., 2011; Kurti & Dallery, 2013; LaLonde et al., 2014; Washington et al., 2014) and results in the individual gaining access to a preferred item upon completion of the desired behavior in an attempt to increase the likelihood of that behavior occurring in the future (Cooper et al., 2007). Verbal praise has been used either independently (Savage, Taber-Doughty, Brodhead, & Bouck, 2018) or as part of a treatment package (Normand, 2008) and is when participants are given praise statements (e.g., “Good job”) upon completion of the desired behavior. Performance or behavior feedback (Hayes & Van Camp, 2015; Hustyi et al., 2011; Normand, 2008; Todd & Reid, 2006) involves providing individuals ongoing information on their performance regardless of whether or not the individual has engaged in the target behavior. The form of feedback can vary. For example, while Normand (2008) provided encouragement statements (e.g., “You’re almost there”) and showed participants graphs of their progress, Hustyi et al., (2011) told participants how close they were to reaching their goal halfway through each session. Finally, self-monitoring (Hayes & Van Camp, 2015; Normand, 2008; Todd & Reid, 2006) involves the individual observing his or own behavior and recording whether or not the target behavior occurred (Cooper et al., 2007). The most common treatment package for increasing physical activity involves goal setting and reinforcement (Kurti & Dallery, 2013; LaLonde et al., 2014; Washington et al., 2014). Additional treatment packages in the literature include self-monitoring, positive reinforcement through tangible items, and prompting (Todd & Reid, 2006); reinforcement through tangible items, self-monitoring, goal setting, and feedback (Hayes & Van Camp, 2015); reinforcement through tangible items, goal setting, and feedback (Hustyi et al., 2011); and positive reinforcement through verbal praise and feedback, self-monitoring, and goal setting (Normand, 2008).

Several studies have evaluated these interventions and their effectiveness to increase physical activity in typically-developing children (Hayes & Van Camp, 2015; Hustyi et al., 2011), adolescents or young adults (Washington et al., 2014), and adults (Kurti & Dallery, 2013; Normand, 2008). Hayes and Van Camp (2015) implemented a treatment package of tangible reinforcement, self-monitoring, goal setting, and feedback to increase the number of steps in six typically-developing 8-year-olds during recess. Steps were monitored on a Fitbit and participants were given a piece of paper with their step goal and were encouraged to monitor their steps on their Fitbit throughout recess. If they reached their step goal, they were given an immediate tangible reinforcer. Step count and time spent engaging in moderate-to-vigorous physical activity were higher during intervention when compared to baseline for all participants.

Similarly, Hustyi et al. (2011) assessed the effectiveness of goal setting, performance feedback, and tangible reinforcement to increase the number of steps in two obese, typically-developing preschoolers during recess. Participants were given a sticker with their step goal on it. After 10 min, the researcher told the participant how many steps they had by checking the participant's pedometer and informed them how many more steps they needed to reach their goal. If participants reached their step goal, they were able to draw a prize from the prize box. One participant increased the number of steps taken from baseline to intervention and consistently achieved his step goals, while the second participant's data were variable and there was considerable overlap when comparing adjacent conditions, indicating this intervention was not effective in reliably increasing her step count.

Washington et al. (2014) used goal setting and positive reinforcement to increase daily step counts in typically-developing college students. Participants could draw from a prize box once a week if they reached their step goals while wearing their Fitbit for the entire week. The prize bowl contained raffle tickets. After drawing a ticket, participants viewed a document that listed the prize associated with each ticket number. Possible prizes included verbal praise and tangible items that included items worth $1-120. Step counts increased during intervention and average daily step counts were above 10,000 steps for 13 of the 15 participants. Similarly, Kurti and Dallery (2013) used goal setting and positive reinforcement to increase step counts in typically-developing adults. This study included two experiments. The first evaluated the effectiveness of goal setting and positive reinforcement to increase steps, while the second intervention was goal setting alone. In the first experiment, participants received money if they achieved their step goals for three out of five days; in the second experiment, participants did not receive any money if they reached their step goals. The second experiment resulted in greater variability in step counts during intervention, but step counts still increased. The results indicated that both interventions were effective in increasing step counts, indicating that although monetary reinforcement may result in more stable patterns of responding, it was not a required component to increase physical activity.

Normand (2008) also used goal setting to increase step counts, but in combination with self-monitoring and performance feedback. The participants included four typically-developing adults who were given pedometers and daily step goals to reach. Participants emailed the researcher with their daily step count. The researcher then responded with performance feedback, which included a praise statement if the participant reached his or her step goal, or feedback encouraging them to reach their goal if they did not. In addition, participants met with the researcher once a week to receive feedback and view their graphed progress. If they reached their goals, they were given praise statements. If they did not reach their goals, they were encouraged to increase their physical activity during the next week. All participants' average step counts increased during intervention phases.

Few articles have used these interventions to increase physical activity in individuals with ASD. Todd and Reid (2006) used self-monitoring, edibles, and verbal cuing to increase snowshoeing and walking or jogging in nonverbal adolescents with ASD. After participants completed an exercise circuit, they placed a token (i.e., a smiley face) on a self-monitoring board. Once they accumulated four tokens, the researchers placed a large smiley face icon on the larger self-monitoring board. Verbal cuing involved vocal prompting to continue exercising or redirecting the participant to return to exercising. Edibles were delivered to each participant after he or she completed a portion of the circuit. Edibles were faded throughout the study. By the end of the study, participants received an edible after completion of the entire circuit. The participants' distance for snowshoeing and walking/jogging increased during intervention.

Savage et al. (2018) used positive reinforcement in the form of verbal praise to increase the number of laps jogged or walked by young adults with ASD and ID. They compared praise delivered in person and praise delivered via audio recording to determine which praise statements were more efficient in increasing physical activity. Both interventions were effective in increasing the number of laps completed by participants. For two of the three participants, praise delivered in person was more efficient and resulted in maintenance and generalization to a new setting.

LaLonde et al. (2014) used goal setting and positive reinforcement through access to a tangible item to increase step counts in young adults with ASD during the school day. Participants were given a step goal and could choose a prize from the prize box if they reached it. In addition, participants could write down their daily step count at the end of the day and note if they met their goal for the day. Steps increased during intervention phases and returned to baseline levels upon withdrawal of the intervention. Social validity was assessed and participants reported that they enjoyed wearing and using the Fitbit to track their steps.

Among other numerous benefits, physical activity is vital for maintaining a healthy lifestyle (CDC, 2018c). As previously discussed, research has indicated that certain treatment packages are effective in increasing physical activity in individuals of all ages with and without ASD and that Fitbits and goal setting are effective tools for increasing physical activity. Only one study (LaLonde et al., 2014) has used Fitbits to monitor the effectiveness of increasing daily physical activity in individuals with ASD. However, this study did not evaluate the effectiveness of increasing physical activity without the use of tangible reinforcement. Additionally, there are no published studies that attempted to increase physical activity levels in adolescents with ID. Therefore, the purpose of this study was to expand the literature on increasing physical activity in adolescents with intellectual and developmental disabilities by determining if using a step goal and a fitness tracker would increase daily step counts in middle schoolers with ID.

Section 2: Research Question

The present study asks the following questions:

1. Does goal setting and using a fitness tracker to monitor steps increase daily steps in middle schoolers with disabilities?
2. Do these behaviors generalize (i.e., do they achieve the same level of step counts) to days in which participants do not receive a step goal (e.g., the weekend)?

Section 3: Method

Participants

To be included in the study, students had to meet the following criteria: (a) eligible for special education services; (b) physically capable of participating in general education physical education; (c) attended school regularly, with no more than eight absences from school for the previous semester, and (d) able to match a number to the same number. Students were not eligible to participate if they: (a) had a diagnosis of a cardiovascular disease or (b) had a diagnosis of any disease that limits mobility (e.g., cerebral palsy).

The researcher interviewed the teacher to determine which students in her class would meet inclusion criteria, including the ability to match a number to its same number. To confirm each participant was able to match numbers, students were given a number on a 25x25 mm piece of paper and then asked to match the same number to its same number out of an array of five 25x25 mm pieces of paper. Students were asked to match five different numbers (15, 27, 100, 350, and 500) and were eligible to participate in the study if they correctly matched four of the five (80%) numbers. A correct response was recorded if the student pointed to or touched the matching number. To be correct, students had to initiate their response within 5 s and complete their response within 10 s of the task direction (e.g., "Match this number to the same number"). All participants scored 100%. Screening data sheets are included in Appendix A.

A teacher interview was conducted regarding each participants' diagnoses, attendance records, and demographic information (e.g., IQ, age). A questionnaire was sent home to each participants' parent(s) to gather information on the student's height, weight, frequency, and topography of physical activity. Social validity questions were also included on the parent questionnaire regarding the parent's attitudes towards physical activity.

Table 1

Participant Demographics

Participant Name	Age (years)	Gender	Race	Disability	IQ
Dwight	14				
Jim	15	Male	Caucasian	ASD, ID	49*
Michael	12	Male	Caucasian	ID, ADHD	46*
		Male	Caucasian	ID	57**

Note. *Weschler Intelligence Scale for Children, 4th ed. **Kaufman Assessment Battery for Children, 2nd ed. ASD – Autism Spectrum Disorder; ID – Intellectual Disability, ADHD – Attention-Deficit/Hyperactivity Disorder

Five students were recommended for the study by the classroom teacher and three met inclusion criteria. All participants were between 12 and 15 years old, were physically healthy, and had full mobility. All participants were in the same special education classroom and could communicate vocally with full sentences. Informed consent was obtained from all participants' parents and assent was obtained from all participants prior to beginning sessions. All participants had exercise routines made by the classroom teacher with the help of a physical therapist that they participated in during their normally-scheduled gym period. The researcher briefly interviewed each participant and asked if they enjoyed exercising, how often they exercised, and what activities they enjoyed in order to get exercise.

Dwight. Dwight's workout routine lasted about 20 min and consisted of: walking down a certain line and walking back; lying on a yoga ball and walking forward with hands; sitting on the yoga ball and raising each leg for three seconds; lying on the yoga ball and completing an activity on the floor; walking up and down the stairs twice; and walking to the end of the hallway and back three times. Dwight reported that he liked to exercise and did so every weekend. Specifically, he enjoyed walking the dogs around the neighborhood and sometimes liked to go to the gym with a family member to do squats and push-ups. Dwight's parent was the only one to return the parent questionnaire. Based off of the completed parent questionnaire, Dwight was six-feet tall and weighed 287 pounds at the time of the study. Therefore, his body mass index (BMI) was 38.9 (CDC, 2015a), placing him in the obese category and therefore at risk for future health problems (e.g., high blood pressure, diabetes, and high cholesterol; CDC, 2018a). Dwight's parent reported that he walked for at least 10 min per day, six days a week and at least 30 min per day three days a week.

Jim. Jim's workout routine took about 30 min and consisted of three sets of five different exercises. Each set was followed by five min of resting before continuing with the next set. The first set included shooting a basketball 30 times, walking two laps, 10 jumping jacks, and running one lap. The second set included 30 s of the grape vine exercise, walking two laps, 10 jumping jacks, and running one lap. The third set included walking three laps while bouncing a ball, 10 jumping jacks, and walking up and down a flight of stairs three times. Jim reported that he liked to exercise and did so every day. Specifically, he liked to run, wrestle, and play baseball and basketball.

Michael. Michael's workout routine was identical to Jim's at the beginning of the study, but was later modified by his classroom teacher. Modifications included removing the grape vine exercise and shooting a basketball, while adding running three laps to each set for a total of nine laps. Michael reported that he liked to play basketball for exercise. When asked how frequently he exercises, he reported that he exercises "100."

Interventionist and Data Collector. The primary data collector was the primary researcher, who was a graduate student working towards her master's degree in Applied Behavior Analysis. She had two years of personal experience working with fitness trackers and goal setting. The classroom teacher had her master's degree in Special Education with a focus in Moderate to Severe Disabilities and a certificate in Autism Spectrum Disorders. She had been teaching at the school for 5 years. She had personal experience with goal setting and fitness trackers.

Instructional Setting and Arrangement

The classroom was a self-contained classroom at a local middle school in a rural area in the Southeastern region of the United States. All participants wore their fitness trackers throughout the day in their typical environments, including at school, at home, and various after-school activities. However, because Michael did not return to school with his fitness tracker for four days, he was instructed to wear his fitness tracker for the duration of the school day and then return it at the end of the day. Participants were given a piece of paper that was then placed in a clear protector pouch that remained in each participant's binder. This paper had each participant's step goal to the right of a pair of footprints that was identical to the icon on the fitness tracker that displayed step counts. The binders also included the participants' daily tasks (e.g., morning work) and remained at their desks throughout the day. Additionally, Jim and Dwight were given a 25x25 mm piece of paper at the end of the school day to take home. This piece of paper had their daily step goal written on it next to the same icon on the paper that remained at their desk. All participants were trained on how to view their steps on the fitness tracker using one-to-one instruction in their classroom by the main researcher.

Materials and Equipment

Participants wore a Fitbit Blaze during baseline and intervention to monitor their daily steps. The basic features of all Fitbit fitness trackers include tracking steps, active minutes, sleep, praise statements once goals are achieved, and prompts to move if the wearer has not achieved his or her hourly step goal. The Fitbit Blaze utilizes additional features, including individualized goal setting in the Fitbit application, tracking fitness zones of activity (e.g., moderate-to-vigorous), and monitoring heart rate (Fitbit, 2018).

Data Collection

Data were collected using permanent products. Each fitness tracker was given an individual account on Fitbit.com. The researcher logged on to each participant's Fitbit account via the Fitbit app and recorded the previous day's steps.

Experimental Design

To evaluate the effect of goal setting on daily step counts, a A-B-A-B withdrawal research design was used. The A-B-A-B withdrawal design is used to answer demonstration questions (i.e., if an intervention has an effect on the target behavior) and establishes experimental control by repeatedly introducing and withdrawing the intervention with the same behavior for each participant and if there are changes in the level with each condition change. With this specific design, experimental control is demonstrated when there are changes in the data paths at three specific points in time: (1) after the first introduction of the intervention, (2) once the intervention is withdrawn, and (3) after the intervention is re-introduced. A-B-A-B withdrawal designs are appropriate to use for reversible behaviors (i.e., behaviors that are easily manipulated with changes in the environment) and are relatively easy to employ, making it useful in practical settings (e.g., the classroom; Ledford & Gast, 2018). Because this study was conducted throughout the participants' day (e.g., classroom, home, other various activities), and the dependent variable was a reversible behavior, this design was appropriate to answer the current research question.

Some disadvantages of this design include ethical concerns, as it temporarily withdraws the intervention. However, because the current study is concerned with increasing physical activity, there are no long-term dangers associated with temporarily withdrawing the intervention. Additional concerns with this particular design include certain threats to internal validity. Specifically, maturation may be a concern if the baseline conditions are lengthy; procedural infidelity and carryover effects may be likely due to the multiple condition changes; attrition may be likely in the second baseline condition; and testing threats are a concern if the testing conditions in baseline sessions are nonpreferred or aversive. However, testing threats are most likely not a concern in the current study because the baseline conditions did not involve any testing.

In addition to the A-B-A-B withdrawal design, a changing criterion design was embedded into B_2. The changing criterion design implements discrete changes in criteria for the target behavior. The previous criterion serves as a baseline for the next criterion level. Therefore, each criterion level must have stable responding with at least three data points before implementing the next criterion change. Each change in criterion should be large enough to be noticeable, but not so large that the individual is not able to reach the new criterion (Cooper et al., 2007). If the target behavior repeatedly changes to meet the new criterion, experimental control is demonstrated with each criterion change (Hartmann & Hall, 1976). Experimental control is further established when the level of responding meets or just passes the criterion level. Changing criterion designs are appropriate for behaviors that are already in the individual’s repertoire and that are able to be discretely increased (Cooper et al., 2007).

Procedures

Dependent variable. The dependent variable was the participants’ step counts. For Jim and Dwight, this consisted of total steps taken throughout the day. For Michael, this consisted of total steps taken throughout the school day. Fitbit uses an accelerometer to track movement. Accelerometers turn movement into data, that are then analyzed by the device to report more specific information on movement (e.g., step count, distance). To count steps, the Fitbit uses an algorithm that determines movement, specifically movements that indicate when the user is walking. Within each algorithm is a movement threshold that, if passed, indicates a step has been taken (Fitbit, 2019). Therefore, one step occurred when the participant moved in such a way that their movement passed this threshold and resulted in a step being recorded on the Fitbit. During intervention, the objective for each participant varied depending on their average baseline step counts. However, each participant's goal included a 10-25% increase in daily steps from baseline.

Training. Before baseline, participants were taught how to use the Fitbits using behavioral skills training (BST). BST consists of providing the individual with instructions, modeling the task or behavior, allowing the individual to practice, and providing feedback on the individual's performance (Morgan & Wine, 2018). First, the primary researcher explained what the Fitbit was and how it works. Specifically, she explained that the Fitbit counted the wearer's steps and physical activity. The researcher then explained how to wear each Fitbit and how to access the step counts on the Fitbit. Second, the researcher modeled and narrated the following steps: putting the Fitbit on, checking the step count, walking across the room with the Fitbit, then checking the steps again to demonstrate the change in the total step count. Third, the researcher allowed each participant to put on the Fitbit and check the steps (with verbal prompts). Participants were then instructed to check the step count, walk across the room, and check the step counts again to see the change in total step count. Finally, the researcher provided any positive or corrective feedback. If any steps were missed or done incorrectly, the researcher prompted the participant through the necessary steps, then provided the participant another opportunity to practice the step and provided verbal prompts if necessary. The researcher ensured that each participant could engage in each step independently before ending the training. Procedural fidelity data were collected on the researcher's training for two of the three training sessions (66% of sessions) and were reported as 100% correct responding for both sessions (see Appendix B).

Baseline procedures. A minimum of five baseline sessions were conducted. Each baseline session involved the participant wearing the fitness tracker throughout the day and data were then collected for each session by recording the participant's step count from the previous day. During baseline sessions, the teacher was responsible for ensuring each participant was wearing his or her fitness tracker at the beginning of the day and instructing each participant to charge his fitness tracker for one hour at a pre-determined instructional time at the beginning of the day when students were typically seated. The teacher did not deliver the participant's daily step goal in baseline sessions.

The first condition (A_1) was implemented until step counts were stable (e.g., all daily step counts were within 25% of each other for three consecutive sessions out of five or more total sessions) or the data path was heading in a contra-therapeutic direction for three consecutive sessions out of five or more total sessions. Baseline data sheets are included in Appendix C.

Instructional procedures. The independent variable was goal setting plus visual aids. During intervention conditions, the teacher delivered a visual daily step goal to each participant, which consisted of a piece of paper within a sheet protector with the participant's step goal next to the footsteps icon. Jim and Dwight also received a 25x25 mm piece of paper with their step goal next to the footsteps icon to take home at the end of the school day. When delivering the step goal, the teacher also verbally told the participants what their step goal was for the day.

Due to the nature of the research question, one session was the length of one day and consisted of that day's total step count. Dwight and Jim wore their fitness trackers throughout the day across all conditions of the study, with the exception of any activities involving water (e.g., showering, swimming) or sleeping. Michael wore his fitness tracker during the school day and removed it before leaving school. During intervention conditions, the teacher was responsible for the following: (a) ensuring each participant was wearing his fitness tracker at the beginning of the day, (b) instructing each participant to charge his fitness tracker at a pre-determined time, (c) delivering each participant's daily step goal verbally, (d) writing the goal in their binder, and (e) writing their goal on a piece of paper for each participant to place in their pocket to take home at the end of the school day (during intervention conditions). The teacher was also trained to collect inter-observer agreement (IOA) data.

Once baseline data were stable, the first intervention phase (B_1) was introduced. During this phase, the researcher worked with each participant to create their step goal. After the participant set their step goal, the teacher gave each participant their goal for the day and their visual aid at the beginning of each day. Each participant's initial step goal was determined based off their average baseline step counts. Participants were then shown a graph of their baseline step counts that included an average line and told what their average step counts had been on school days since they had been instructed to wear the fitness tracker. After explaining the graph, the researcher explained to the participant that he was going to have to try and reach a step goal each day now. The researcher then asked the participant what he wanted that goal to be. If the participant needed help determining his step goal (e.g., said "I don't know" or gave an inappropriate step goal; e.g., 50,000 steps), the researcher provided two options for the step (i.e., a 10% or 25% increase). To prevent the participant from choosing an inappropriate step goal or choosing a step goal that was difficult to recall (e.g., not a rounded number, 8,723), two options were given to the participant to give them the choice between two appropriate goals as determined by the researcher. The goal options were calculated by multiplying each participant's baseline average step count by .10 or .25, adding this number to the average, and rounding the number to the closest hundred. For example, if the baseline average was 6,803 steps, this was multiplied by .10 or .25, yielding a product of 680.3 or 1,700.25, respectively. Each number was then added to the average, yielding a sum of 7,483.3 or 8,503.75, respectively. Finally, each number was rounded to the closest hundred, yielding the final step goals: 7,500 or 8,500. After the participant chose which goal he wanted to work towards, the teacher verbally stated the goal, wrote it on the appropriate paper, and placed it in his binder.

After each participant reached the mastery criterion (e.g., meeting or exceeding step goal for three consecutive sessions) within at least five total sessions, the intervention was removed and baseline conditions were in place and participants did not receive a daily step goal for at least five sessions, or until these data were stable. Finally, the intervention (B_2) was re-introduced and the teacher resumed giving each participant a daily step goal with the visual aid. The final intervention condition differed from the first, in that a changing criterion design was embedded into the A-B-A-B withdrawal design during B_2. If a participant reached his step goal in B_2 for three consecutive sessions, the step goal increased by 5% for the next day. The intervention was again withdrawn after the participant reached his step goal for three consecutive sessions at the next criterion level.

Modifications. Two modifications were made for Michael. Because he was not reliably wearing his fitness tracker to school, the first modification made involved instructing him to leave his fitness tracker at school at the end of the day instead of taking it home. The second modification made involved adding a tangible reinforcement component contingent upon reaching his step goal.

Generalization

Generalization sessions were conducted for Jim and Dwight. Because the classroom teacher was responsible for delivering each participant's daily step goal, generalization sessions were conducted on the weekends when the classroom teacher was not with the participants to deliver the goal. Therefore, generalization sessions were similar to baseline sessions, in that participants did not receive a daily step goal. However, baseline and generalization sessions did differ in environments, as baseline sessions included attending school and generalization sessions did not. Because Michael did not reliably bring his fitness tracker to school, he was instructed to leave it at school at the end of the school day. Therefore, generalization sessions were not conducted for him.

Reliability

The researcher conducted reliability data for IOA and procedural fidelity. Reliability data were collected for at least 20% of all sessions. Because the data were collected via permanent product, any disagreements were discussed. If procedural fidelity fell below 80%, the researcher reminded the teacher of the procedures. Baseline IOA data sheets are located in Appendix D and baseline procedural fidelity data sheets are located in Appendix E. Intervention IOA data sheets are located in Appendix G and intervention procedural fidelity data sheets are located in Appendix H.

Dependent variable reliability. Reliability data were collected for at least 20% of all sessions per condition to assess agreement. IOA sessions involved the primary researcher logging onto the account for each fitness tracker and recording the previous day's step counts. The secondary data collector then looked at the step counts and recorded the number on the data sheet. Both data collectors then compared the recorded step counts. IOA was calculated using exact agreement IOA, which involves dividing the number of intervals with 100% agreement by the total number of intervals, then multiplying this number by 100. However, because there was only one interval per session, the agreement was either 100% or 0%. The data collectors discussed any sessions with 0% agreement.

Procedural fidelity. The primary researcher collected procedural fidelity data on the classroom teacher to ensure the teacher was reliably checking that each participant is wearing the fitness tracker, charging the fitness trackers during the specified time, and delivering each participant's step goal verbally and on paper during intervention. The researcher used a checklist to ensure the teacher was completing each step. Procedural fidelity was then calculated by calculating the number of observed behaviors, dividing that number by the number of planned behaviors, and multiplying by 100.

Results

IOA and procedural fidelity data were collected in each condition for at least 20% of all sessions within each condition. IOA data were collected for 68% of all of Jim's sessions across conditions and was 100% agreement. IOA for Michael was collected for 80% of all sessions across conditions and was 100%. IOA data for Dwight were collected for 65% of sessions and was 100%. Procedural fidelity data were collected for 34% of Jim's sessions and 70% of Michael's sessions and procedures were implemented with 100% fidelity. Procedural fidelity data were collected for 33% of Dwight's sessions and procedures were implemented with 98% fidelity.

Section 4: Results

Effectiveness of Goal Setting and Intervention

Jim.

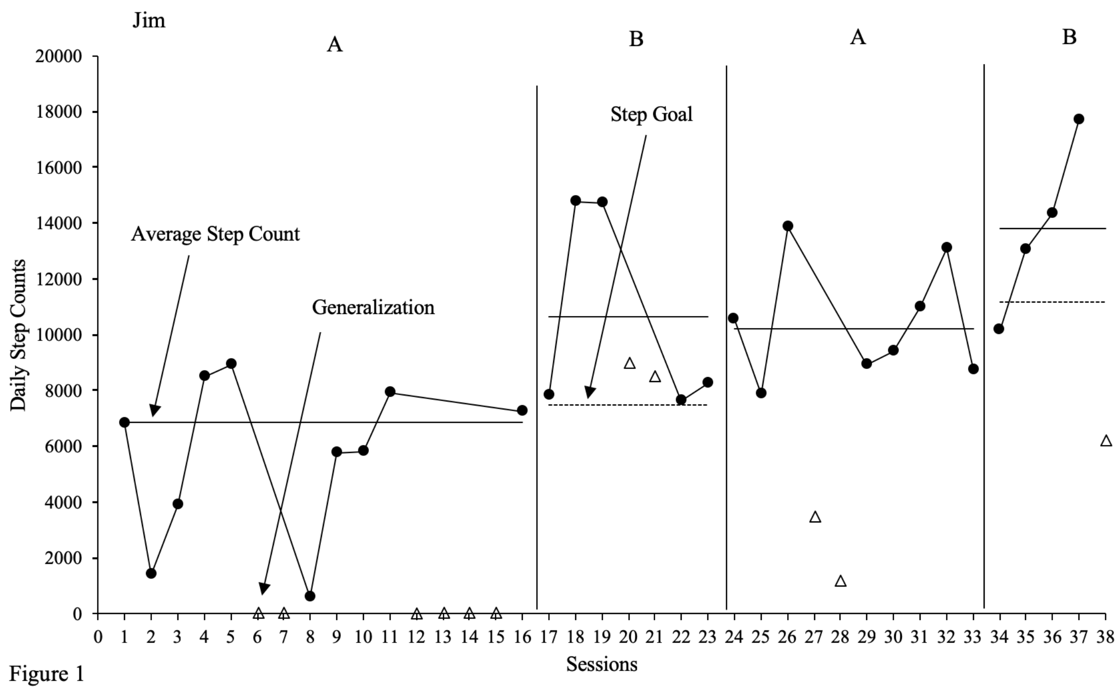

Figure 1

A_1. Jim's average baseline step count was 6,868 steps per day (range 1,419-8,942). Baseline lasted 16 sessions (i.e., days), but only eight sessions were considered when making experimental decisions. The data within this condition were highly variable.

B_1. Jim's daily step goal was 7,500 steps. The data within this condition were variable but were consistently above his step goal. Jim's average intervention step count was 10,640 steps, which was over a 50% increase from his baseline average, indicating there was an overall change in level from A_1 to B_1. Jim met or exceeded his step goal for 100% of intervention sessions. Intervention was removed after Jim met his step goal for three consecutive sessions.

A_2. Upon removal of the intervention, Jim's step counts did not return to baseline levels and remained consistent with his intervention step counts, indicating the intervention may have generalized to the second baseline condition. His average step count during A_2 was 10,674 steps (range, 7,854-13,849) and each baseline session was over his intervention step goal. The data within this condition were highly variable but consistently above 7,500 steps. When comparing A_2 and B_1, there was virtually no change in level and there was considerable overlap between the conditions. When comparing similar conditions, both A_1 and A_2 were variable but did not have similar levels. During the second baseline condition sessions, Jim mentioned several times that he was working towards his step goal.

B_2. Jim's step goal for B_2 was 11,200 steps, which he met or exceeded for 75% of intervention sessions. Upon introduction of the intervention, there was not an immediate change in level and there was overlap when comparing A_2 and B_2. However, the average for this condition's step count was 13,814 steps (range, 10,187-17,692), which was just under a 30% increase from A_2's average step count, indicating there was an overall change in level from A_2 to B_2. The data within this condition were heading in a therapeutic trend. When comparing similar conditions, both B1 and B2 were consistently above the step goal. However, they did not share similar trends or overall levels. Although this condition consisted of a changing criterion design, only one criterion was set before removing the intervention.

Dwight.

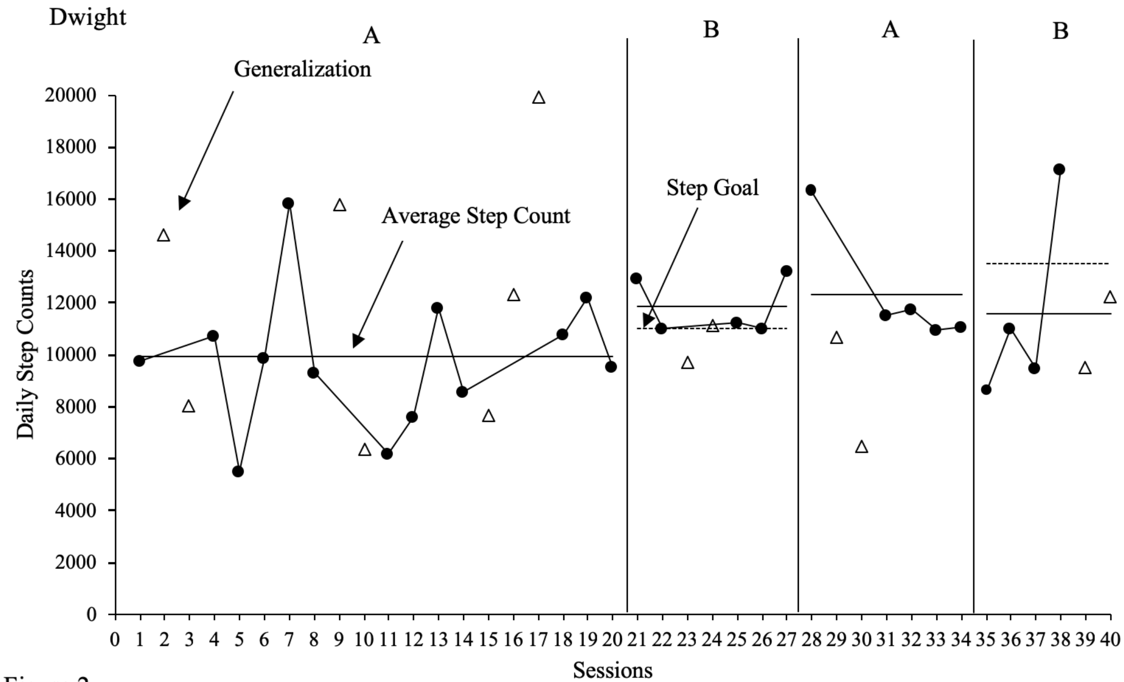

Figure 2

A$_1$. Dwight's average baseline step count was 9,928 steps per day (range 5,482-15,821). Baseline lasted 20 sessions (i.e., days), but only 13 sessions were considered when making experimental decisions. The data within this condition were highly variable.

B$_1$. Dwight's daily step goal was 11,000 steps. His first intervention step count was an almost 30% increase from his baseline average. Dwight's average intervention step count was 11,873 steps. The data within this condition were relatively stable. Upon introduction of the intervention, there was an immediate increase in level and step counts stabilized. Dwight met or exceeded his step goal for 100% of intervention sessions. Intervention lasted seven sessions but only five sessions were considered when making experimental decisions. Intervention was removed after Dwight met his step goal for three consecutive sessions.

A_2. Dwight's average step count for the second baseline condition was 12,307 steps (range 10,926-16,269). When comparing B_1 and A_2, there was some overlap and carryover from B_1 to the first session of A_2. However, following this session, the data were consistently stable. His step counts did not revert back to baseline levels and remained consistent with his intervention step counts, indicating the intervention may have generalized to the second baseline condition. When comparing similar conditions, there was no similarity between A_1 and A_2 in trend, level, or stability. The second baseline condition lasted seven sessions, but only five sessions were considered when making experimental decisions.

B_2. Dwight's step goal was 13,500 steps for B_2, which he met or exceeded for 25% of intervention sessions. The data within this condition were variable and there was no trend in the data path. Upon introduction of the intervention, there was an immediate change in level in a contratherapeutic direction. When comparing similar conditions, B_1 and B_2 were similar in overall level, but were not similar in trend or stability. Although this condition consisted of a changing criterion design, only one criterion was set before removing the intervention.

Michael.

Michael

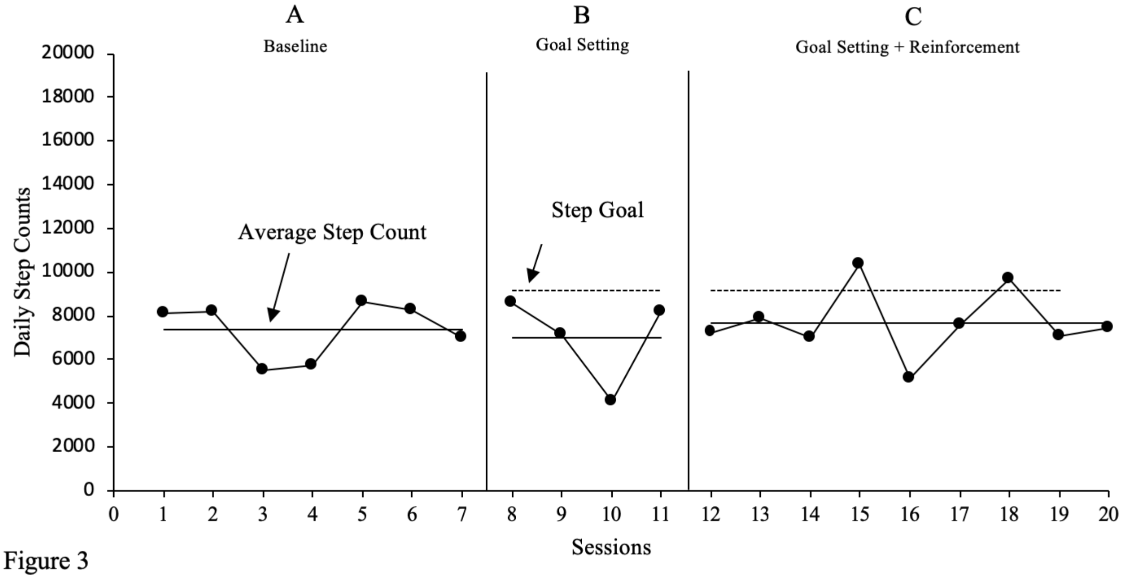

Figure 3

A₁. Michael's average baseline step count was 7,352 steps per day (range 5,509-8,662). The data within this condition were stable. Baseline lasted seven sessions (i.e., days).

B₁. Michael's daily step goal was 9,200 steps. The data within this condition were relatively stable and were heading in a contratherapeutic direction for the first three sessions. Upon introduction of the intervention, the dependent variable moved in a contratherapeutic direction and there was no change in the overall level when compared to the baseline condition. Additionally, when comparing A_1 and B_1, there was considerable overlap in the data paths for both conditions. Michael met his step goal for 0% of the sessions.

C₁. After the fourth consecutive session of not meeting his step goal, the researcher made the first modification. Michael was given a 'First-Then' board and was told he could earn extra time playing on his computer or with his cars upon meeting his step goal for the day. 'First-Then' boards are a type of visual support that display the contingency and ("Visual Supports for Children with ASD") are often used to help individuals understand what must happen in order to earn his or her reinforcer. His step goal was 9,200 steps. He met his step goal on the fourth and seventh intervention sessions in this condition, therefore meeting his step goal for 22% of intervention sessions. The data within this condition were relatively stable in level but did not demonstrate any consistent trends. When comparing B_1 and C_1, there was no change in overall level between the two conditions.

Generalization

Generalization sessions were conducted for Jim and Dwight. Because the classroom teacher was responsible for delivering each participant's daily step goal, generalization sessions were conducted on the weekends when the classroom teacher was not with the participants to deliver the goal. Therefore, generalization sessions were identical to baseline sessions, in that participants did not receive a daily step goal. Participants were instructed to wear their fitness trackers over the weekend during baseline and intervention. Because Michael was not reliably bringing his fitness tracker to school, he was instructed to leave it at school at the end of the school day. Therefore, no generalization sessions were conducted for him.

Jim. Jim typically did not wear his fitness tracker on days in which he did not attend school. His generalization step counts during baseline averaged 202 steps per day (range, 0-1,419). After the intervention was introduced, his generalization step counts averaged 8,746 steps per day (range, 8,493-8,999) and he exceeded his step goal by nearly 1,000 steps for both generalization sessions. Upon removal of the intervention, his generalization step counts decreased to an average of 2,341 steps per day (range, 1,191-3,492).

Dwight. Dwight's generalization step counts during B_1 averaged 12,106 steps per day (range, 6,332-19,933). After the intervention was introduced, his step counts for generalization sessions averaged 10,428 steps per day (range, 9,723-11,133). He did not reach his step goal during the first generalization session but exceeded his step goal during the second generalization session by 133 steps in B_1.

Section 5: Discussion

Implications

The purpose of this study was to evaluate the effectiveness of goal setting with a fitness tracker to increase daily step counts in adolescents with ID. Jim consistently met or exceeded his step goal in intervention sessions. Dwight consistently met or exceeded his step goal in the first intervention condition but did not reliably meet his goal in the second intervention session. Michael only met his step goal for two intervention sessions after introducing a reinforcement component. Dwight's step counts exceeded the recommended step guidelines (i.e., 10,000 steps) for 63% of all sessions and Jim's step counts exceeded the step guidelines for 37% of all sessions and were consistently over 10,000 steps at the conclusion of the study. Michael never reached the recommended step guidelines.

Both Jim and Dwight met or exceeded their first step goals in the second baseline condition after intervention was first introduced and then removed, indicating the target behavior did not reverse. Both participants maintained the same level of step counts in B_1 and A_2, further indicating that the intervention generalized to days in which they did not receive a step goal.

These results indicate that implementing a step goal without any additional components may be effective in increasing step counts in adolescents with ID. By not implementing any socially-mediated reinforcement, the intervention was more realistic and therefore conducive to maintaining the behavior after the conclusion of the study. However, this intervention was not effective for Michael. Michael was more motivated to achieve his step goal after the tangible reinforcement component was added, indicating that goal setting alone may not be motivating enough for some and therefore not effective for all adolescents with ID.

Goal setting is a common practice for making improvements in a variety of domains (e.g., physical fitness, professional development, and academia) and is easy to implement. Because of the ease of implementation, this intervention is practical to utilize in classrooms for adolescents. Although it was not effective for all participants, goal setting did result in basic demonstrations of effect for some participants. This being said, it is possible that goal setting was effective in increasing step counts in two participants. Although there was no functional relation present in this study, the increases in step counts and lack of reversibility in the behaviors do lend to discussion on what warrants a reversible behavior.

Previous research on increasing physical activity has utilized a variety of treatment packages to do so. However, the amount of research on increasing physical activity in this particular population is scarce. In the published literature for this population, zero studies have evaluated the effect of goal setting alone to increase physical activity. If future researchers can find an effective intervention that increases physical activity in individuals with disabilities, it will be lifechanging for this population. Therefore, it is imperative that this topic be further studied. Although this study does not add to the existing literature on increasing physical activity in adolescents with ID, it does provide important discussion on what constitutes a reversible behavior and will be helpful in investigating this behavior for future research.

Limitations and Future Directions

There were a few limitations in the present study. First, there were two instrumentation errors in which the dates on Dwight's Fitbit were incorrect. The data points from those days were not included. Therefore, there was no session for those particular dates. Second, because the teacher nor the researcher were present during generalization sessions, procedural fidelity could not be assessed. Finally, although the dependent variable was a reversible behavior, the major limitation to this study was the ultimate irreversibility of the target behavior. The target behavior did not reverse for any of the participants, which could have happened due to a combination of reasons. It is possible that although participants did not receive a step goal, they still remembered their step goal that was previously given to them. Therefore, the intervention was not entirely removable. Furthermore, in combination with the intervention not being entirely removeable, reaching a step goal may have been automatically reinforcing to Jim and Dwight. Although they did not receive any socially-mediated reinforcement (e.g., rewards, edibles, social praise), they may have enjoyed the act of achieving their goal, thus increasing the likelihood that they continued to reach their previously given step goal even in days in which they did not receive a goal. Therefore, future research should evaluate this intervention with a different experimental design (e.g., multiple baseline) that does not rely on reversing the behavior for demonstrating experimental control.

Additionally, it is possible that the Fitbit itself contributed to the behavior not reversing. Having ongoing access to their step count may have been motivating for Jim and Dwight to continue getting their steps in throughout the day in an attempt to reach their step goal. Future research should evaluate number of step counts achieved throughout the day with and without the presence of the Fitbit to see how the Fitbit influences step counts. Lastly, future research should also evaluate this intervention with different types of physical activity (e.g., running, frequency of workouts per week) to see with what activities this intervention is effective in. Although this study focused on individuals with disabilities, this research should be applied to a variety of populations (e.g., typically-developing adults, children with or without disabilities).

Appendix A

Screening Data Sheet

Student Initials: ________
Researcher Initials: ______

Date:	
Time:	
Stimulus	**Response (+ or –)**
% Correct	

+ = Correct – Identified correct matching number by pointing, touching, or verbally stating the number; must initiate within 5 s and complete response within 10 s of the task direction
– = Incorrect – Does not identify the correct matching number, initiates after 5 s, and/or completes the task after 10 s of the task direction

Appendix B

Procedural Fidelity
Behavior Skills Training: Fitbits

Date: ______
Start time: _________
End time: _________
Participant ID: _______
Researcher: ______________
Observer: _____________

Explanation	**+ or –**
Explains what the Fitbit is (e.g., fitness tracker that counts steps)	
Discusses that the Fitbit counts steps and tracks physical activity	
Explains how to wear each Fitbit	
Explains how to access each Fitbit's step count (explanation will vary based on model)	
Modeling	**+ or –**
Demonstrates how to put each Fitbit on the wrist for right-handed *and* left-handed users	
Demonstrates how to check each Fitbit's step count (will vary based on model)	
Walks across the room and back, then demonstrates how to check step count again	
Practicing	**+ or –**
Directs the participant to practice putting on the Fitbit	
Directs the participant to practice checking the step count	
Directs the participant to walk across the room and check their steps after walking	
Ensures the participant is able to complete each step without prompting before ending training	
Feedback	**+ or –**
Provides corrective feedback for each step in which the participant made an error or did not respond	
Provides verbal praise for each step in which the participant completed correctly (with or without prompts)	
Total +	/
% of correct responding	

Appendix C

Baseline Data Sheet

Fitbit/Participant ID: ________ Condition: BL
Researcher Initials: ______
Date: ______

Session #	Date of Steps	Step Count

Appendix D

Baseline IOA Data Sheet

Fitbit/Participant ID: ________
IOA Researcher Initials: ______
Date: ________

Condition: BL - IOA

Session #	Date of Steps	Step Count	Primary Researcher – Step Count	Agreement (+) or Disagreement (-)
			% of agreements =	

Appendix E

Baseline Treatment Fidelity Data Sheet

Researcher Initials: _______ Condition: BL – TF
Session #: ______
Date: ______

Did the teacher ensure each participant was wearing his or her fitness tracker?	Y N
Did the teacher charge each fitness tracker during the specified time?	Y N
% correct responding	

Appendix F

Intervention Data Sheet

Fitbit/Participant ID: ________ Condition: IV
Researcher Initials: ______
Date: ______

Session #	Date of Steps	Step Count	Step Goal	Met Goal
				Y N
				Y N
				Y N
				Y N
				Y N
				Y N
				Y N
				Y N
				Y N
				Y N
			% sessions met step goal	

Appendix G

Intervention IOA Data Sheet

Fitbit/Participant ID: ________ Condition: IV – IOA
IOA Researcher Initials: ______
Date: _______

Session #	Date of Steps	Step Count	Step Goal	Met Goal	Primary Researcher – Step Count	Agreement (+) or Disagreement (-)
				Y N		
				Y N		
				Y N		
				Y N		
				Y N		
				Y N		
				Y N		
				Y N		
				Y N		
				Y N		
			% sessions met goal		**% of agreements =**	

Appendix H

Intervention Treatment Fidelity Data Sheet

Researcher Initials: _______ Condition: IV – TF
Session #: ______
Date: ______

Did the teacher ensure each participant was wearing his or her fitness tracker?	Y N
Did the teacher write down each participant's correct daily step goal on a piece of paper, hand it to them, *and* say "Your goal is ______ steps for today," at the beginning of the day?	Y N
Did the teacher charge each fitness tracker during the specified time?	Y N
% correct (Y) responding	

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