2011

Physical Activity Promotion among School-Aged Children Using Pedometers and Rewards

Kari E. Ek
University of South Florida, ekk@mail.usf.edu

Physical Activity Promotion Among School-Aged Children Using Pedometers and Rewards

by

Kari E. Ek

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
Department of Child and Family Studies
College of Behavioral and Community Sciences
University of South Florida

Major Professor: Raymond G. Miltenberger, Ph.D.
Kimberly Crosland, Ph.D.
Timothy Weil, Ph.D.

Date of Approval:
June 23, 2011

Keywords: Exercise, Goals, Step Count, Reinforcers, Contingencies

Table of Contents

List of Figures

Abstract

Physical activity is important for children as many children are considered overweight or obese. The benefits of exercise have been demonstrated in empirical studies across all age ranges (Horne, Hardman, Lowe, & Rowlands, 2009; Kelly et al., 2004; Louie & Chan, 2003; Southard & Southard, 2006). In the current study, a multiple baseline design across participants was used to assess the effectiveness of goal setting, reinforcement contingencies, and pedometers that provide feedback to increase step count of 5 participants. During baseline each participant wore a sealed pedometer to assess the average steps the participants took per day. After baseline, each participant, researcher, and parent set a reasonable goal of steps to achieve per day in order to receive a specific reinforcer chosen by the parent and participant. A behavioral contract stated the specific goal number of steps for the day and the specific reinforcer they would receive. At the end of each day before the child went to bed, the parent recorded the number of steps and provided the child with feedback about whether reinforcement was earned. Data collection for four of the five participants showed a mean increase in steps taken per day during intervention 1 in comparison to baseline levels. Participants met their goal step counts during intervention 1 on 12%, 35%, 50%, 71% and 76% of days. All three participants that participated in intervention 2 increased their mean count from both baseline and intervention 1 levels. Participants met their goal step counts during intervention 2 on 62%, 100%, and 100% of days. Two participants participated in the

follow up phase of the study; both participants maintained their goals from intervention 2 and completed their goal step count on 100% of days.

Introduction

There is a well known need for increasing physical activity among children. The benefits of exercise have been demonstrated in empirical studies across all age ranges (Horne, Hardman, Lowe, & Rowlands, 2009; Kelly et al., 2004; Louie & Chan, 2003; Southard & Southard, 2006). One serious problem is childhood obesity; therefore it is important to develop good physical activity habits in early childhood as a way to combat the development of obesity. The National Health and Nutrition Examination Survey (NHANES) from 2007-2008 indicates that 17 percent of children ages 2 to 19 are obese. Between the years of 1976-1980 and 1999-2000 the obesity rate increased from 6.5% to 19.6% (Center for Disease Control and Prevention, 2010). Many children are not getting an adequate amount of exercise due in part to the abundance of video games available to them. In 1999 children 8 to 18 years of age played an average of 26 min of video games per day. In 2009 1 hr and 13 min of video game time was played per day, a 236% increase in 10 years (The Henry J. Kaiser Family Foundation, 2010). Sixty-six percent of these children that play video games state they have no rules on the amount of time they can spend playing the video games (The Henry J. Kaiser Family Foundation, 2010). Making video game time contingent upon completion of exercise has proven effective in adults (Allen & Iwata, 1980) and needs to be assessed in children as well.

Tudor-Locke et al. (2004) conducted a study to establish an average number of steps recommended for children to reach each day. The researchers wanted to establish

this number in order to report the proportion of children falling above or below this level in order to establish behavior change goals. This was accomplished by conducting a secondary analysis of existing data collected from 1,954 children, 6 to 12 years old. Pedometers were selected to count steps because of their high reliability and validity and the fact that they are inexpensive to use. The participants wore sealed pedometers to guard against reactivity to the device. The researchers determined that four days was an adequate amount of time to show habitual activity in children, therefore, the pedometers were worn from morning to night for four consecutive days. They used sex and age appropriate body mass index (BMI) guidelines to categorize the weight status of the participants in to normal weight, overweight, or obese. BMI is a weight index that takes height into account. Normal weight is a BMI of 18.5 to 24.9, overweight is 25-29.9, and obese is over 30 (National Heart Lung and Blood Institute). According to the Centers for Disease Control and Prevention website, which the current research project used to assess the BMI of each participant, a BMI of 23 or higher was considered obese. The results indicated that girls in the normal weight category had an average step count between 12,210 and 13,625 steps per day. The girls in the overweight category had an average step count between 10,388 and 11,520 steps per day. Boys in the normal weight category had an average step count between 15,118 and 17,548 steps per day. Overweight boys had an average step count between 12,342 and 14,290 steps per day. The researchers then determined that the cut point for children between the ages of 6 and 12 should be 12,000 steps per day for girls and 15,000 steps per day for boys. This means that girls that take fewer than 12,000 steps per day and boys that take fewer than 15,000 steps per day are more likely to be classified as overweight or obese according to the current BMI

guidelines. This breaks down into 120 min, or 2 hrs of physical activity per day for girls and 150 min or 2.5 hrs of physical activity per day for boys. This assessment of the average step counts for normal weight children has been used in numerous studies to act as a guide or goal in order to decrease weight and increase physical activity amongst children (Belton, Brady, Meegan, & Woods, 2010; Duncan, Al-Nakeeb, Woodfield, & Lyons, 2007).

Ozdoba, Corbin, and Masurier (2004) investigated whether school-aged children showed any reactivity when monitored by unsealed pedometers. Thirty-five children from two different fourth grade classrooms participated in the study. During week one, the first class wore sealed pedometers for four days. During week two, both classes wore unsealed pedometers. During week three, only class two wore sealed pedometers. The step counts over the three week period were very consistent, which showed no reactivity among school-aged children while wearing the unsealed pedometers. Several studies have proven that pedometers are reliable and valid in their use with adults (VanWormer, 2004) as well as children (Oliver, Schofield, Kolt, & Schluter, 2007 & Ozdoba et al., 2004).

Southard and Southard (2006) looked at promoting exercise in children using an internet based game called MetaKenkoh. MetaKenkoh is an adventure game which promotes physical activity and healthier food choices in children ages 9 to 11. In this game the child plays the role of a hero who must save the land of MetaKenkoh from an alien called Rowgoth. Along the journey the child can obtain rewards by answering health and fitness related questions. The game also gets parents involved by having them upload activity data recorded by pedometers worn by the children, into the database each

day. The number of steps the child takes during the day according to the pedometer readings becomes "ergs" which are the energy units that the character needs in order to play the game. When the character runs out of these "ergs" the character becomes unresponsive until the child engages in more steps recorded by the pedometer and a parent uploads this new information. The participants selected were 120 children ages 9 to 11. The study lasted five weeks, one week of baseline and four weeks of intervention. During the intervention phase the children were randomized to either the game play group, (intervention), or the monitoring group (control). During the time of this publication 77 participants have completed both the baseline and week one of the study. They found that underweight and normal weight children in the intervention group had a marked increase in steps from the baseline, whereas step counts for children in the control group decreased. In the overweight category both of the groups (intervention and control) showed a slight increase in step counts. These results shows that reinforcing increased steps of normal weight children with the MetaKenkoh video game was effective, whereas overweight children were unaffected by the video game as a reinforcer for engaging in physical activity.

Goldfield et al. (2006) looked at an open loop feedback on television viewing and physical activity in children who were overweight and obese. Thirty families were included in the study. The criteria for inclusion in the study included: having at least one child between 8 and 12 years old, categorized as overweight or obese according to the BMI, who watched at least 15 hrs of television per week, and engaged in physical activity less than 30 min a day. The thirty families were randomly assigned to the open-loop feedback plus reinforcement or the open-loop feedback alone conditions. In both groups

the children wore pedometers that counted their daily steps. The pedometers were unsealed to provide feedback. During the open-loop feedback plus reinforcement condition, access to television was based on the frequency of steps recorded. To obtain one hr of television the child needed to engage in enough physical activity to accumulate 400 steps on the pedometer. The television in the participant's house was controlled by an electronic device and only turned on if a token was inserted into it; each token allowing 30 min of viewing time. After the 30 min elapsed the television automatically turned off. Therefore the only way to watch television was to obtain the token by engaging in physical activity. During the first week of the intervention the children's television time was not limited. During the following weeks the number of tokens earned from the previous week determined the amount of viewing time they would receive. The results showed no significant difference between the intervention and control group during baseline for amount of time wearing the pedometers. The intervention group showed significant reductions in sedentary behavior over time as well as an increase physical activity performed to above 30 minutes a day. During the intervention phase the intervention group (feedback plus reinforcement) showed a significantly greater change in total step counts compared to the control group (feedback alone). The intervention group also had greater improvements in weight loss and reductions in their BMI throughout the study. This study showed that a reinforcement procedure paired with the feedback can be beneficial in increasing physical activity among overweight and obese children.

Goldfield, Kalakanis, Ernst, and Epstein (2000) also assessed open-loop feedback systems effect on the physical activity in children who were obese. Thirty-four children,

ages 8 to 12 years, participated. The study consisted of two phases, a 20 minute physical activity phase, and a 10 minute reinforcement phase. The amount of activity engaged in during the 20 minute physical activity phase determined the amount of time they were allowed to play video games or watch television during the 10 minute reinforcement phase. Each participant was randomly selected to experience one of three contingencies. In the contingent 1500 group the participants had to accumulate 1500 steps to earn 10 min of reinforcement. In the contingent 750 group the participants had to accumulate 750 steps to earn 10 min of reinforcement. A control group was also assessed in which the participants had free access to the reinforcers. The physical activities selected for inclusion in this study included a stair climber and a trampoline. The reinforcers selected for this study included a Super Nintendo video game system with various games, a VCR and television with movies, and reading materials for children. Results showed the contingent 1500 group had significantly higher pedometer ratings than either the contingent 750 or control group and that the contingent 750 group had significantly higher pedometer ratings than the control group. These finding indicate that obese children will increase their engagement in physical activity in order to earn reinforcers, such as television, computer, or video game time.

Roemmich, Gurgol, and Epstein (2004) compared changes in physical activity between youth who participated in either an open-loop feedback condition (experimental group) or a no feedback condition (control group). The experimental group, consisting of 11 children, wore accelerometers in which they could see the recorded activity counts. Each time the participants in the experimental group reached a score of 400 activity counts they received 60 min of television time toward the following week. The control

group, consisting of seven families, wore accelerometers that had the screens turned off so no feedback was provided. In addition, they did not have the reinforcement contingency of watching television. Participants in the experimental group showed a 24% increase in physical activity compared to their baseline rates. The experimental group demonstrated a 32% increase in physical activity and 22% less television watching than the control group. This study showed the importance of having feedback and reinforcement contingencies to increase physical activity amongst youth.

One way to promote increases in exercise is to set obtainable goals. McKay et al. (2008) studied the use of pedometers and setting standard goals to promote physical activity. One hundred twenty three participants, 16 to 84 years old, were recruited from their primary care provider. Each participant was given a pedometer pack that included a pedometer with instructions, a leaflet on the benefits of walking, and a step count card in which to record his or her steps. After baseline was conducted the participants went through a four stage intervention, each stage was 3 weeks long. In each stage the goal was to achieve a certain number of steps greater than that of baseline. The first stage's goal was to reach 1,500 steps per day greater than during baseline, 3 days a week; the second stage's goal was to reach 1,500 steps per day greater than during baseline, 5 days a week; the third stage's goal was to reach 3,000 steps per day greater than during baseline, 3 days a week; and the fourth and final stage's goal was to reach 3,000 steps per day greater than during baseline, 5 days a week. The results showed that during baseline the mean step count was 4,422 per day. The mean step count was 6,641 steps during the first phase, 6,877 steps during the second phase, 8,254 steps during the third phase, and 8,906 steps per day during the fourth phase. The average increase was approximately

4,500 steps per day over baseline. This study showed that shaping the behavior of the participants in small increments to reach a desired goal can prove effective.

Up to this point only a handful of studies have looked at the impact of reinforcers delivered contingent upon increased numbers of steps as measured by pedometers with children. These studies have evaluated reinforcement systems involving feedback or TV or video time contingent on increasing steps. Although the results are promising one of the limitations of some of the previous studies was that they used specialized reinforcers, such as tokens to put in a modified television and computer games that require inputting data. There is a need for research to look at how individualized reinforcement programs using available reinforcers in the home will affect the number of steps taken per day. In addition combinations of procedures such as the use of goal setting, gradual increases in exercise, and reinforcement have not been evaluated. There also is a need for research to evaluate combinations of procedures as combined procedures might produce greater changes in behavior. The current study looked to promote physical activity among young children, as measured by pedometers, by using goal setting and individualized reinforcement administered by parents in the home. A goal number of steps was determined for each day and specific reinforcers were delivered contingent upon reaching the goal. The study had parents and children involved in choosing specific reinforcers that the parents could provide on a daily basis at no cost, such as the opportunity to watch TV or play video games. The use of reinforcers currently available in the home that did not incur additional costs is different from past research, most of which involved specialized reinforcers that were at more cost to the researchers and parents. By using individualized, available reinforcers administered by the parents, the behavior change

may be more likely to generalize and maintain after the research study is complete. All reinforcers were individually chosen for each participant, already available, and contingent on the number of steps the participant took each day.

Method

Participants

Five participants were recruited from the local community by means of flyers posted at local businesses asking parents to call or e-mail the researcher if they have children with obesity in the desired age range and would like more information about the study. The researcher contacted interested parents, set up a meeting, and conducted a consent meeting for parents and children interested in participating. Participants were typically developing children ranging in age from 8 to 11 years old (third to sixth grade). Participants' BMIs were assessed in order to categorize each child's weight as normal weight, overweight, or obese. Children with a BMI of 23 or more were included in the study because children with a BMI of 23 or more are considered to be overweight or obese, according to the Centers for Disease Control and Prevention website's BMI calculator for children. At the initial meeting with each participant and parent, the researcher assessed any medical concerns to determine if inclusion in the study was favorable (see Appendix A). The parents were asked via a questionnaire about medical conditions (e. g., asthma, epilepsy, physical limitations or disabilities, etc.) that might interfere with exercise and about whether they would find an increase in exercise acceptable and desirable for their children. Informed consent was obtained from each participant's parent or legal guardian for inclusion in the study as approved by the USF IRB.

Emma was a ten year old girl with a BMI of 34.9. She lived with her mother, who was a single parent. Her initial step goal was 5,000 steps and she was first working for tokens to earn toys and then computer time. Jenny and Jerome were brother and sister, whom lived with their mother. They frequently were watched by their mother's sister or other relatives. Jenny was an eight year old girl with a BMI of 23.0. Jenny's initial goal was 9,000 steps and she was working for tokens to earn toys/activities from mom. Jerome was an eleven year old boy with a BMI of 30.9. His initial goal was 10,000 steps per day and his reinforcement was tokens to earn toys/activities from mom. Nicole was a ten year old girl with a BMI of 23.1. She got home from school around 3 pm every day. Her initial step goal was 11,000 steps and she was working for Silly Band ™ at first and then time on the computer. Jon was a 10-year-old boy with a BMI of 23.0; he lived with his mom and dad, and got home from school around 3 pm each evening. Jon's initial goal was 11,000 steps and he was working for time with his itouch ™.

Setting

During baseline, intervention phase 1 and 2, and follow up, each participant wore a pedometer, from the point of waking up to bed time, in all settings throughout the day. Goal setting, contract preparation, and pedometer checks occurred in the home. Reinforcement for achieving the predetermined goal of steps completed per day was given either at home or in the community.

Materials

Yamax Digi-Walker model SW-200 ™ pedometers were used to assess step counts for each participant. This particular pedometer has been used in numerous studies

and has been assessed as both valid and reliable. Each participant was given a waist band in which to attach the pedometer. Data sheets were provided to each parent to record the number of steps taken each day. During the intervention phase an interview was conducted with each participant and parent to set a specific goal and identify reinforcers for each participant. Reinforcers included time spent with preferred items, such as the computer or itouch ™ or earning money to purchase items. Reinforcers consisted of items or activities already available at no cost to the families (or reflecting expenditures the family would have made independent of participation in the study).

Validity and Reliability

The Yamax Digi-Walker model SW-200 ™ pedometer was shown in research to be both a valid and reliable instrument prior to use in this study (Oliver et al., 2007 & Ozdoba et al., 2004). In addition we conducted a reliability and validity assessment as part of this study. Validity measures were conducted by having individuals wear the pedometer for 15 min while using a clicker counter to count the number of steps taken. Validity was assessed as the individuals walked and jogged both outside and on the treadmill. The percentage of agreement was calculated by dividing the larger number by the smaller number and multiplying by 100%. Five validity assessments were conducted and the results ranged from 97.9% to 99.8% with a mean of 99.16%. Reliability of the pedometers was assessed by having individuals wear two pedometers at the same time, one on the right hip and one on the left hip. Two individuals assessed reliability by walking on the treadmill, walking in the mall, walking the dog, and walking outside. Each of the 5 assessments was 15 min in duration. The percentage of agreement was

calculated by dividing the larger number by the smaller number and multiplying by 100%. Reliability percentages ranged from 89.3%- 99.9% with a mean of 95.12%.

Target Behavior and Data Collection

The target behavior for each participant was the number of steps recorded on the pedometer per day. During the baseline and intervention phases data were collected at the end of each day, before the participant went to bed. The participant's parents recorded the number of steps taken per day on the data sheets provided. A research assistant called, texted or e-mailed the parents each night and asked the parents for the pedometer number to ensure the parents check and record daily. The pedometer was reset each morning by the parents before being placed back onto the child.

Interobserver Agreement

The parent of the child served as the primary observer and another parent, family member, or sibling served as a secondary observer. Interobserver agreement (IOA) was calculated for the step count recorded by the pedometer on at least 33% of the days, by having the secondary observer also record the step count during those days. IOA was calculated by dividing the smaller number by the larger number of steps recorded by two parents and multiplying by 100. Emma's IOA was calculated on 47.7% of days and had an agreement of 100% between the two observers. Jenny and Jerome's IOA was calculated on 100% of days and had an agreement of 100% between the two observers. Nicole's IOA was calculated on 35% of days with 100% agreement between the two observers. Jon's IOA was calculated on 33% of days with 100% agreement between the two observers.

Experimental design

A multiple baseline design across participants was used to assess the effectiveness of increasing step counts by using goal setting, reinforcement contingencies, and pedometers that provide feedback to the participant. For two individuals, a changing criterion design was used to evaluate the effects of the intervention

Procedure

During the initial meetings each participant's BMI was assessed by weighing the participant, measuring the participant's height, and calculating BMI using the formula found at the Centers for Disease Control and Prevention website http://apps.nccd.cdc.gov/dnpabmi/. A questionnaire was provided at that time to both the participant and parent to determine specific reinforcers for each child, and specific instruction were given on how to use the pedometer (see Appendix B).

Baseline. Each participant was given a sealed pedometer to ensure the child was unaware of the step count throughout the day. Each participant had a waist band in which to attach the pedometer. Each morning the parent helped the child attach the pedometer after the child was dressed for the day. Baseline continued for approximately 2 to 8 weeks to ensure an adequate representation of the current number of steps each child took per day. Parents unsealed the pedometers each night, recorded the number of steps, and resealed the pedometer to be put back on in the morning. The pedometer was reset each morning by the parent.

Intervention 1. After baseline was completed, the researcher conducted a meeting with both the parent and the participant and provided information on how to obtain the

recommended number of steps (12,000 for girls, 15,000 for boys), and how the participant can reach his or her daily goal. The family was told how many minutes of exercise produced a certain step count on the pedometer. An example would be that 2 hrs of exercise per day would produce a step count of 12,000. The researcher and family then discussed the types of exercise the participant might engage in to produce these steps each day, such as rollerblading, running, walking the dog, or playing various sports. Each child, along with a parent and researcher set a reasonable goal of steps to achieve per day in order to receive the reinforcer. The goal, based on the baseline level of the behavior, was meant to increase step count by at least 33% and more if needed. A series of increasing goals was set to reach the final goal.

After establishing the goal level, the reinforcer for achieving the goal was determined by the parent, child, and researcher. Reinforcers included gaining access to preferred items, such as time spent on the computer or itouch ™ and earning money or tokens to buy other reinforcers. Reinforcers were occasionally changed or added throughout the experiment depending on the level of responding (step count increasing). Each morning the parent reset the pedometer so it read zero steps, helped the child attach the pedometer, and reminded the child what he or she could do to increase steps and what reinforcers were available for reaching the goal number of steps. A behavioral contract was presented to the participant at each goal step that stated the specific goal number of steps for the day and the specific reinforcer he or she could receive. Both the parent and participant signed the behavioral contract at each goal step (see Appendix C for an example of the contract). Because the pedometer was unsealed during the intervention phase, the child had free access to reading the pedometer and could thus use the

information to decide if he/she wanted to exercise more depending upon the goal number of steps.

At the end of each day before the child went to bed, the parent checked the pedometer, recorded the number of steps (see Appendix E), and provided the child with feedback about whether the reinforcer was earned as stated in the behavioral contract. The parent showed the child the number of steps on the pedometer and told the child either a) that the goal had been reached and the reward was earned (based on the contract) or b) that the goal was not reached, how many steps were achieved, and how many more were needed to achieve the goal. Participants were allowed access to these reinforcing items during the day up to a predetermined amount of time set by the researcher, child, and parent in the contract. The following day was when the reinforcer was given for the goal met the previous day. If the contract contingency was not met, the reinforcer was withheld the following day. The researcher called, emailed, or texted the parent every night to ensure that they had collected data and asked whether or not the reinforcer, if earned from the previous day, was delivered. The researcher also asked the parents questions about how well the reinforcer was working for the child. This included questions such as "What activities did the child engage in during that day?", "Are these activities affecting the amount of time the child is engaging in exercise?", and "Do you believe the reinforcer being used is effective in changing the amount of exercise with your child or is their other reinforcers that would be more effective?" The researcher also asked whether the parent believed that the child had tampered with the pedometer when conducting spot checks.

Spot checks were conducted throughout the day by parents to assess if tampering with the pedometer had occurred, such as shaking the pedometer to increase the step counts without actually engaging in exercise. During the spot check, the parent wrote down the time and the pedometer reading to note whether an unusually large number of steps has occurred since the last check (see Appendix D). The parent also identified whether the child had an opportunity to accumulate these steps through exercise in the time period since the last check. Parents did not directly ask the child if they had tampered with the pedometer so as not to entice them to do so. Parents conducted spot checks during both the baseline and intervention phases. Parents did so during baseline by removing the sticker, checking the pedometer, and placing a new sticker on the pedometer.

Intervention 2. Intervention 1 was intended to teach parents how to reward their children to increase their step counts each day. However, even though an increased mean was shown for 4 out of the 5 participants, the participants were not meeting their goals. Therefore intervention 2 was introduced. Intervention 2 was identical to intervention 1, except there were added daily phone calls from the researcher to either the participant or the parent. These phone calls were daily after school hours between 3pm and 5pm. The phone calls were intended to have the participants discuss with the researcher or parent how many steps they had achieved for that day, how many steps they had left to reach their goal and what they planned to do to achieve the goal amount of steps.

Follow up. After the intervention phases were completed, follow up occurred for the remaining 2 participants. Each participant wore a sealed pedometer, providing no feedback to the participant. The participant received the reinforcer that was used during

the intervention phase each day based on whether the parent believed the child engaged in an appropriate amount of physical activity, similar to the activity the child engaged in during the intervention phase. The reinforcer was not contingent on whether the child reached his or her previously set goal. Therefore the parent decided each evening whether or not the child has earned the reinforcer before checking the pedometer. After deciding this, the parent recorded the number of steps as shown on the pedometer, on the data sheets (see Appendix F). Researchers used the data to determine if maintenance and generalization has occurred.

Results

Data collection showed a mean increase in steps taken per day for four of the five participants during intervention 1 in comparison to baseline levels (Figure 1). Three of the five participants showed a mean increase in steps taken per day during intervention 2 in comparison to both baseline levels and intervention 1.

Emma increased her mean step count of 3,267 steps during baseline to 4,963 steps during the first intervention phase; this was a 52% increase from baseline. During the first intervention Emma reached above her goal of 5,000 steps on 35% of days (compared to 22% in baseline). During the intervention phase Emma had two outliers in her data; the increased number of steps occurred from her playing with her cousins during Christmas break.

Jerome increased his mean step count from 9,515 steps during baseline to 11,476 steps during intervention 1 and 15,579 during intervention 2; which was a 21% and 64% increase from baseline respectively. Jerome reached his step count of 10,000 steps on 76% of days during intervention 1 (compared to 62% in baseline). He reached his step goals of 10,000, 12,000, 14,000, and 15,000 steps during 100% of days during both intervention 2 and follow up phases. Jerome's BMI at the conclusion of the study was 30.8, virtually the same as the 30.9 recorded at the start of the study.

Jenny increased her mean step count from 9,767 steps during baseline to 10,391 during intervention 1 and 13,338 during intervention 2; which was a 6% and 37% increase from baseline respectively. Jenny reached her step goal of 9,000 steps per day 71% of the time during intervention 1 (compared to 38% in baseline). She also reached her step goals of 9,000, 11,000, and 12,000 on 100% of days during intervention 2 and follow up phases. Jenny's BMI at the conclusion of the study was 22.9, opposed to 23.0 at the start of the study.

Nicole increased her mean of 9,796 steps during baseline to 11,906 steps during intervention 1 and 13,111 steps during intervention 2; which was a 21.5% and 34% increase from baseline respectively. Nicole reached her step goal of 11,000 steps during 50% of days during intervention 1 and 62% of days during intervention 2 (compared to 36% in baseline).

Jon decreased his mean step count from 9,327 steps during baseline to 8,933 during intervention 1; which was a 4% decrease from baseline. Jon reached his step count of 11,000 steps per day on 12% of days during intervention 1 (compared to 27% in baseline).

Social Validity Results. The social validity questionnaire was completed by 4 out of 5 of the participants' parents (see Appendix G). When asked how effortful was it to implement the daily reward program with your child, the average response was a 4.5 on a 5 point scale showing that it was between somewhat effortful and very effortful. When asked "How disruptive was the daily reward program to their daily routine or their child's daily routine?" the average response was 1.75 meaning it was not very disruptive.

Parents answered “How well they believe the daily reward program worked?” with an average response of 4.0 indicating somewhat well. When asked “How much did your child like participating in this research study?” all parents marked a 5 for very much. When asked “How much did you like participating in the research study?” the average response was 4.75 with three out of the four parents putting a 5 for very much. The average response to the question, “How resistant was your child to completing their daily step count?” was a 2.25, meaning not very resistant. Parents reported on average a 4.0 for the question, “How often they thought their child got the reward even if he or she did not complete the step count?” The final question was “What percentage of the days did you follow through with the consequences?” Two of the four parents marked between 50-75% of days and the other two marked between 75-100% of days.

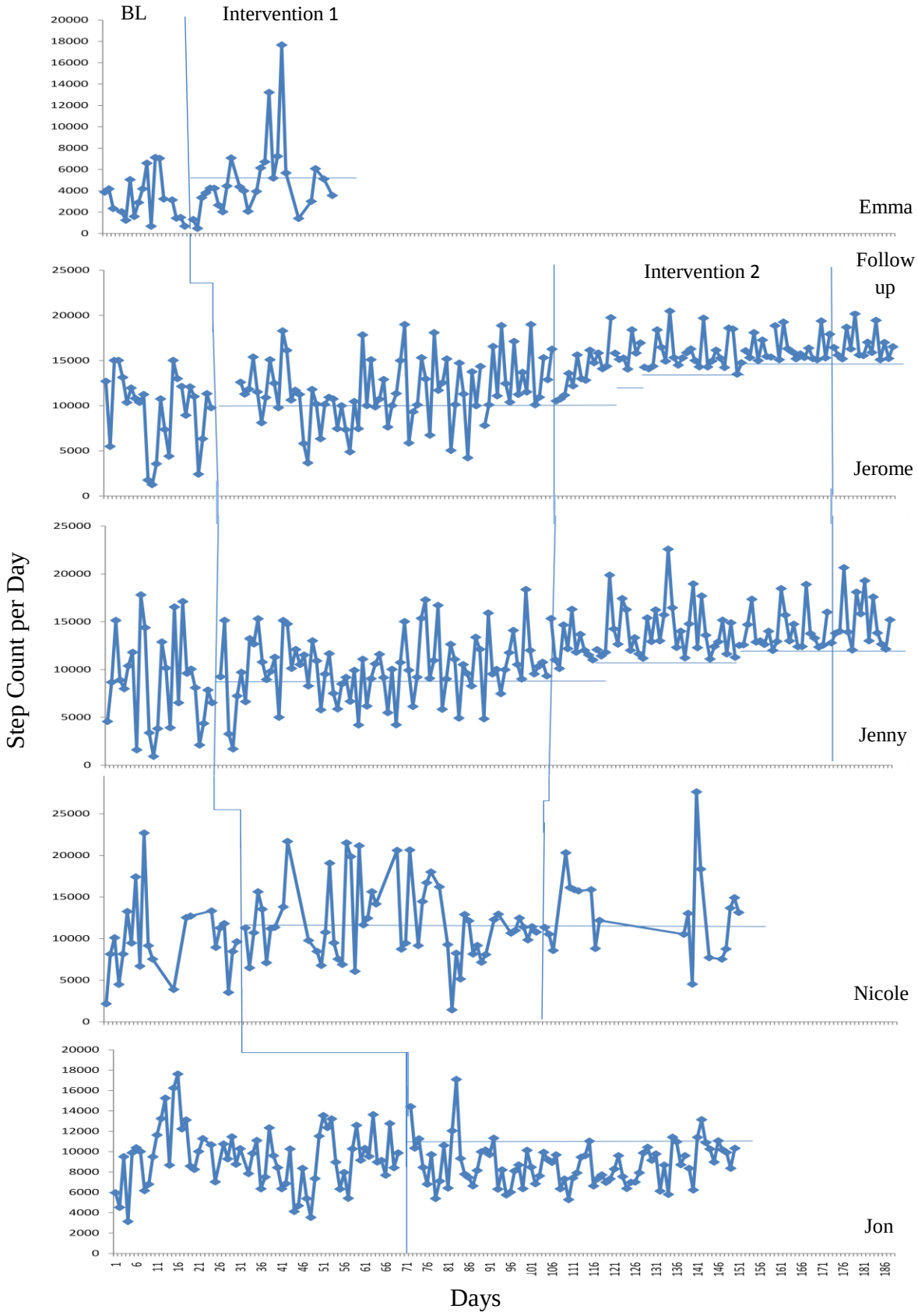

Figure 1. Multiple baseline across participants showing step counts per day

Discussion

For four out of five participants, intervention 1 successfully increased step counts from baseline levels; however intervention 2 was required to further increase step counts to the levels for girls and boys identified by Tudor-Locke et al. (2004) as being associated with normal weight. The three participants that continued to intervention 2 showed a marked increase in step counts, with two of them reaching their goal step counts on 100% of days. The two participants that continued the study into follow up continued to achieve their goal step count on 100% of days.

The results of the current study mirrored results from Goldfield et al. (2000) and Goldfield et al. (2006) showing that feedback plus a reinforcement procedure can be beneficial in increasing physical activity among overweight and obese children. However, the change in behavior was not as large as we had originally hoped during intervention 1. Therefore the results are possibly more similar to Southard and Southard (2006), which showed that reinforcing an increase in step count worked for normal weight children but not for overweight children. The children in the current study were overweight and were not as responsive to the intervention in the study until another component was added during intervention 2. Unlike Southard and Southard (2006) we did not include normal weight children in the study to compare to the overweight or obese children. The current study also showed that open loop feedback from the pedometers allowed participants to increase their step counts just as Roemmich et al.

(2004) had previously demonstrated. Providing children with open loop feedback about the number of steps taken per day during intervention 1 and 2 allowed four out of five participants to increase their step count from baseline, in which no feedback was provided.

Intervention 2 was more successful than intervention 1 possibly due to the reminder each day after school that was delivered to the participants. During the daily phone call, the researcher asked the participants how many steps they currently had, how many they had left to achieve their goal for the day, and what their plan was to achieve that goal. This phone call ensured that each child was reminded of their participation in the study and that they would receive their reinforcer only if they achieved their step count. They also needed to come up with a plan to tell the researcher. This phone call from the researcher could have functioned in a number of ways. It may have operated simply as a prompt for the child to initiate some physical activity. It may have generated some rule governed behavior in the child such that the child directed himself or herself to engage in exercise to meet the daily goal. The reminder may have functioned as an aversive stimulus or may have generated verbal behavior that was aversive (e. g., "If I don't go for a walk I won't get to play video games tomorrow") and the aversiveness could only be escaped once the child engaged in exercise and achieved the step count for the day. This aversiveness may not have been created from the parents in intervention 1, perhaps because the contract was reviewed first thing in the morning, the parent was not present after that, and child forgot about it (did not continue to state the rule about exercise and the daily consequence) as the day progressed.

During the course of this study several challenges were encountered. One such challenge was the level of involvement of the parents. The parents needed to be very involved during intervention 1 for it to be effective. In addition to reviewing the daily step count with the child and implementing the contingency, they were required to send the researcher data each day via text message, email, or phone conversation. However, they rarely sent data on a daily basis. The researcher gave several prompts for parents to send the data to the researcher, but it was collected mostly in weekly sets. This delay in receiving data made it difficult to make phase changes according to the data. Another challenge was the sometimes less than expected involvement of the parent in the daily contingencies. The parents presence can act as a discriminative stimulus for the children to complete the daily step count because the parents implement the contingencies. If parents weren't involved with their children on a daily basis completing the contingency the children were less likely to complete the step count than if parents were constantly and consistently reminding their child to complete their step count each day.

When setting goals for each participant, researchers made decisions based on a 1,000 to 2,000 step increase from baseline. For both Emma and Josh the goals may have been set too high and thus, limited their success in this research study. For Emma the initial goal may have been too much of an increase; with her baseline mean at 3,267 steps and her goal set at 5,000 steps, a 35% increase from baseline. This goal was determined because Emma had the greatest number of steps to increase to reach her goal of 12,000 steps. However, the large initial increase may have not allowed her to contact reinforcement on enough days during intervention 1 and ultimately caused her to withdraw herself from participation. Jon's mean in baseline was 8,933 steps per day and

his goal was set at 11,000 steps, which was a 19% increase. This goal may also have caused him to not come into contact with the reinforcement as frequently as the researchers would have liked. For future research, goals should be picked based on a reasonable percentage increase (e.g., 10%) and not on 1,000 to 2,000 step increases or based on how far the participant has to get to the ultimate goal.

Another problem that was encountered was changes in the schedules of each participant, due to such events as the weather, vacations, or whether they had recess at school or not. These events seemed to interfere with the child's exercise. The weather may have been a factor in whether the participants reached their goal. Several of the parents of the participants reported that they would not allow their child or children outside when the weather was too cold or rainy. This inability to go outside to play could have affected the children reaching their step count during poor weather conditions. In addition, time away from home and altered schedules during vacations made it harder for the children to achieve their goal number of steps for the day. Parents also reported that recess or lack of recess at school affected whether or not their child achieved their step count for the day. For example, Nicole's mother reported that on several of the days when Nicole achieved a step count well above her goal she had recess in school.

Issues of pedometers breaking or resetting were present for two out of the five participants. Jerome broke his pedometer playing football between baseline and intervention 1. This delayed his involvement in intervention 1. Nicole broke three pedometers in the course of this study and had one pedometer that frequently reset on her, which resulted in the loss of data for several days.

Based on the increased effectiveness of intervention 2, future research could help parents increase their children's step counts more effectively by having them set an alarm on their cell phone or watch to alert them each afternoon after their child is out of school. When the alarm buzzes they would be required to call or ask their child how he or she is doing on the step count for the day and ask all of the same questions the researcher had previously asked during intervention 2. This strategy would allow the researcher to not be so heavily involved and prompt the parents to provide the reminders that the child will only receive their reinforcer if the step count goal is met for the day.

Booster sessions for the parents may also need to be investigated in future studies. In such booster sessions, researchers could come to the participants' home and observe the morning routine of placing on the pedometer and talking about the reinforcer for that day or the after school phone call or face-to-face questions about the child's current step count. The researcher would then provide specific feedback to the parents about fidelity, the best techniques to motivate the child, and ensure the reinforcer is strong enough for behavior change on a weekly basis.

Future research could also look into creating a package that relies less on parents implementing contingencies and more on researchers providing the reinforcement. Sometimes it is difficult to rely on parents to consistently implement daily contingencies without letting other extraneous variables come into play, such as problem behaviors (for example, fighting with siblings). A potential problem is having reinforcers taken away contingent on problem behavior even though they have been earned as a result of achieving step count the previous day. Future research should also look at other effective ways of reminding children to put on the pedometers each morning and to check

them throughout the day. For example, making a pedometer area in the bathroom that would allow easy access and reminders to wear the pedometer. Reminders to check their step count throughout the day could be given through means of text messages to the children, a wrist band that states "check your pedometer" or states a goal number of steps. Teachers could also be involved with the study and remind students to check their pedometers and encourage exercise. Although we believed reactivity might be an issue through the current study, frequent spot checks by the parents showed that children were not shaking the pedometer in order to accumulate steps faster. This is consistent with the studies conducted by VanWormer, (2004), Oliver et al. (2007) and Ozdoba et al., (2004) which showed that neither adults nor children showed reactivity to wearing the pedometers when unsealed. An issue that was not foreseen was the reactivity of other children that surround the participants. Parents and participants reported that other children would ask about the pedometer or want to play with it, and even teased one participant for wearing it. This attention and teasing caused Nicole to frequently "forget" to wear her pedometer. Reactivity to the comments of others should be accounted for in future studies. One way to deal with this extraneous variable is to have less noticeable pedometers, such as wrist band pedometers that also act as watches, and are indistinguishable from watches.

This study added to the literature by showing that a parent package for increasing their children's exercise habits, in which parents were required to deliver reinforcers to their children for reaching a specific step count, can be somewhat effective. However, the study also showed that increases in step count were modest and highly variable from day to day when parents implemented the contingencies. When the researcher took an active

role and contacted participants on a daily basis, it resulted in higher step counts for each child. Based on this result, it seems that daily reminders may need to be put into place for the child to reach the desired step count.

References

Allen, L.D. & Iwata, B.A. (1980). Reinforcing exercise maintenance using existing high-rate activities. *Behavior Modification*, 4 (3), 337-354.

Belton, S., Brady, P., Meegan, S., & Woods, C. (2010). Pedometer step count and BMI of Irish primary school children aged 6-9 years. *Preventive Medicine,* 50, 189-192.

Centers for Disease Control and Prevention (2010). BMI Percentile Calculator for Child and Teen English Version. Retrieved from http://apps.nccd.cdc.gov/dnpabmi/

Center for Disease Control and Prevention (2010). Childhood overweight and obesity. Retrieved from http://www.cdc.gov/obesity/childhood/index.html

Duncan, M.J., Al-Nakeeb, Y., Woodfield, L., & Lyons, M. (2007). Pedometer determined physical activity levels in primary school children from central England. *Preventive Medicine,* 44, 416-420.

Goldfield, G.S., Kalakanis, L.E., Ernst, M.M., & Epstein, L.H. (2000). Open-loop feedback to increase physical activity in obese children. *International Journal of Obesity,* 24, 888-892.

Goldfield, G.S., Mallor, R., Parker, T., Cunningham, T., Legg, C., Lumb, A., Parker, K., Prud'homme, D., Gaboury, I., & Adamo, K.B. (2006). Effects of open-look

feedback on physical activity and television viewing in overweight and obese children. A randomized, controlled trial. *Pediatrics,* 118(1), 157-166.

Horne, P.J., Hardman, C.A., Lowe, C.F., & Rowlands, A.W. (2009). Increasing children's physical activity: a peer modeling, rewards and pedometer-based intervention. *European Journal of Clinical Nutrition,* 63, 191-198.

Kaiser Family Foundation (2010). Generation M2: Media in the lives of 8- to 18-year-olds, p. 1-49. Retrieved from http://www.kff.org/entmedia/upload/mh012010presentL.pdf

Kelly, L.A., Reilly, J.J., Fairweather, S.C., Barrie, S., Grant, S., & Paton, J.Y. (2004). Comparison of two accelerometers for assessment of physical activity in preschool children. *Pediatric Exercise Science,* 16, 324-333.

Louie, L. & Chan, L. (2003). The use of pedometry to evaluate the physical activity levels among preschool children in Hong Kong. *Early Child Development and Care*, 173(1), 97-107.

Lubans, D.R., Morgan, P.J., Callister, R., & Collins, C.E. (2009). Effects of integrating pedometers, parental materials, and e-mail support within an extracurricular school sport intervention. *Journal of Adolescent Health*. 44, 176-183.

McKay, J., Wright, A., Lowry, R., Steele, K., Ryde, G., & Mutrie, N. (2008). Walking on prescription: The utility of a pedometer pack for increasing physical activity in primary care. *Patient Education and Counseling*, 76, 71-76.

National Heart, Lung, and Blood Institute (2010). Calculate your body mass index. Retrieved from http://www.nhlbisupport.com/bmi/.

Oliver, M., Schofield, G.M., Kolt, G.S., & Schluter, P.J. (2007). Pedometer accuracy in physical activity assessment of preschool children. *Journal of Science and Medicine in Sport,* 10, 303-310.

Ozdoba, R., Corbin, C., & Masurier, G. L. (2004). Does reactivity exist in children when measuring activity levels with unsealed pedometers? *Pediatric Exercise Science,* 16, 158-166.

Roemmich, J.N., Gurgol, C.M., & Epstein, L.H. (2004). Open-loop feedback increases physical activity of youth. *Journal of the American College of Sports Medicine,* 36 (4), 668-673.

Southard, D.R. & Southard, B.H. (2006). Promoting physical activity in children with MetaKenkoh. *Clinical Investigative Medicine,* 29(5)293-297.

Springer, A.E., Kelder, S.H., & Hoelscher, D.M. (2006). Social support, physical activity and sedentary behavior among 6th grade girls: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity,* 3, 8.

Tudor-Locke, C., Pangrazi, R.P., Corbin, C.B., Rutherford, W.J., Vincent, S.D., Raustorp, A., Tomson, L.M., & Cuddihy, T.F. (2004). BMI-referenced standards for recommended pedometer-determined steps/day in children. *Preventive Medicine,* 38, 857-864.

VanWormer, J.J. (2004). Pedometers and brief e-counseling: Increasing physical activity for overweight adults. *Journal of Applied Behavior Analysis,* 37, 421-425.

Appendices

Appendix A: Medical Conditions Questionnaire

1. Does your child have any medical conditions that may prohibit or limit his or her ability to engage in exercise or sustained physical activity such as walking, running, outdoor games, or sports? Yes /No

   If Yes, please explain _____

2. What (if any) medical conditions does your child currently experience? (circle)

High blood pressure	Yes No
Diabetes	Yes No
Heart problems	Yes No
Blood clots	Yes No
Asthma	Yes No
Breathing problems	Yes No

   Other: _____

   Would any of these conditions limit your child's ability to exercise?

   If yes, please explain. _____

3. Do you believe that your child can exercise continuously for 30 minutes to an hour without any medical issues? Yes /No

Appendix B: Reinforcement Questionnaire

1. What activities does your child engage in most frequently when he/she has free time?

   _____ _____
   _____ _____
   _____ _____
   _____ _____
   _____ _____

2. How much time does your child spend engaging in each of these activities?

   _____ _____
   _____ _____
   _____ _____
   _____ _____
   _____ _____

3. If not previously mentioned above, how much time per day does your child spend engaging in:

   a. Video game play (Nintendo DS or DSi, Playstation, Wii, GameCube, Xbox 360, etc.)?

      _____

   b. TV/Movie time?

      _____

4. What items/activities does your child find reinforcing that you would be willing to use for this study that you could give your child each day (i.e. video game time, TV/movie time)?

   _____
   _____

Appendix C: Behavioral Contract

I, _____(*Participant's name)*, agree to complete _____ steps (*predetermined step count)* on _____(*day/date).* If I complete the step count I will receive _____ (*specific reinforcer).* If I do not complete the step count I will not receive _____ (*specific reinforcer).*

Signed: _____ _____

Participant Parent/Guardian

Appendix D: Spot Check Data Sheets

Date	Time of Spot Check	Step Count	Activities Child engaged in Since Last Check
Example: 9/25/10	*3 pm*	*2,500*	*School*
Example: 9/26/10	*5 pm*	*14,500*	*2 hours walking*

Step Count Estimation Chart	
1,000 steps	10 minutes of walking
5,000 steps	50 minutes of walking
10,000 steps	100 minutes of walking (1 hr 40 min)
15,000 steps	150 minutes of walking (2 hr 30 min)

Appendix E: Baseline/Intervention Data Sheets

Date	Pedometer Goal (Intervention only)	Steps Taken	Reinforcer Received (Intervention only)
Example: 9/25/10	*10,000*	*10,500*	*1 hour video games*
Example: 9/26/10	*10,000*	*9,022*	*none*

Appendix F: Follow up Data Sheets

Date	Time Spent & Type of Exercise	Steps Taken	Reinforcer Received
Example: 9/25/10	*2 hours walking* *30 minutes biking*	*10,500*	*1 hour video games*
Example: 9/26/10	*30 minutes walking*	*4,022*	*none*

Appendix G: Social Validity Measure of Integrity

Please circle the response for each question that best matches your experience with this research study.

1. How effortful was it to implement the daily reward program with your child?

Very Effortful	Somewhat Effortful	Neutral	Not Very Effortful	Not at All Effortful
5	4	3	2	1

2. How disruptive was the daily reward program to your daily routine or your child's daily routine?

Very Disruptive	Somewhat Disruptive	Neutral	Not Very Disruptive	Not at All Disruptive
5	4	3	2	1

3. How well do you believe the daily reward program worked?

Very Well	Somewhat Well	Neutral	Not Very Well	Not at All Well
5	4	3	2	1

4. How much did your child like participating in this research study?

Very much	Somewhat	Neutral	Not Really	Not at All
5	4	3	2	1

5. How much did you like participating in this research study?

Very much	Somewhat	Neutral	Not Really	Not at All
5	4	3	2	1

6. How resistant was your child to completing their daily step count?

Very Resistant	Somewhat Resistant	Neutral	Not Very Resistant	Not at All Resistant
5	4	3	2	1

7. How often do you think your child got the reward even if he or she did not complete the step count?

Very Often	Somewhat Often	Neutral	Not Very Often	Not at All
5	4	3	2	1

7. What percentage of the days did you follow through with the consequences? (gave the reward when your child achieved the step count goal and withheld the reward when your child did not reach the step count goal). Place an X along the continuum.

0%----------25%----------50%----------75%----------100%