USING NEGATIVE REINFORCEMENT AND LOSS AVERSION TO INCREASE DAILY STEPS WALKED

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By
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CERTIFICATION OF APPROVAL

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DEDICATION

This thesis is dedicated to my parents. Without their unwavering support, I never would have pushed myself to pursue a higher education. Thank you for always encouraging me to do my best.

ACKNOWLEDGEMENTS

Special thanks to Dr. Potter, Dr. Hesse, and Ms. Bianchi for all your help and guidance in this process. Thank you for working with me to accomplish my goal in a limited amount of time.

Thank you to my husband, Sam, for always supporting me in my educational endeavors and encouraging me to do my school work. Thank you to my son, Flynn, for giving me a reason to finally finish my degree.

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ABSTRACT

Three female participants ages 18 to 33 years old wore Fitbit Flex fitness trackers to examine how goal setting paired with negative reinforcement and loss aversion could help increase the number of steps per day they walked. A multiple baselines across participants coupled with an ABA reversal design was used. Participants earned money for reaching their step count goals. All three participants increased their steps per day when the goal setting and loss aversion contingencies were in place, relative to the baseline and follow up phases.

INTRODUCTION

It is no secret that obesity has become a large scale issue for Americans, and the issue is worsening rather than improving. Data from the 2009-2010 National Health and Nutrition Examination Survey found more than two out of three adults are considered overweight or obese (Flegal, Carroll, Kit, & Ogden, 2012). In a more recent National Health and Nutrition Examination Survey, data suggested in 2011 to 2014, 36% of adults were considered obese alone; this does not include persons who would be classified as overweight (Ogden, Carroll, Fryar, & Flegal, 2015). Obesity is defined as a body mass index (BMI) of 30 or higher, while overweight is defined as a BMI of 25-29.9 (Centers for Disease Control and Prevention, 2016). Body mass is calculated by dividing an individual's weight in kilograms by his height in square meters (Centers for Disease Control and Prevention, 2016). Being overweight or obese are both risk factors for other serious health concerns, such as Type 2 diabetes, heart disease, high blood pressure, and even some types of cancer (National Institute for Diabetes and Digestive and Kidney Diseases, 2012). Not only does obesity cost a person his or her health, it is also associated with higher medical costs. Finkelstein, Trogdon, Cohen, and Dietz (2009) found obesity contributed an estimated $147 billion to medical costs annually. They also found per capita medical costs for obese individuals were approximately $1,429 higher than medical costs for average weight individuals in 2006.

The questions that remain are what contributes to obesity, and how can we ameliorate the current situation? Overweight and obesity are caused by an imbalance in energy consumption and expenditure (National Heart Lung and Blood Institute, 2017). This means when a person consumes more calories than he or she expends, those extra calories lead to weight gain. In order to maintain a healthy weight, one must have a balance between calories consumed and expended. To lose weight, one must expend more calories than he or she consumes. One easy, cost effective, and popular way to burn calories and exercise is walking.

It is important to have an objective measurement of walking in order to keep track of energy expenditure. Pedometers measure walking by counting the wearer's steps. Wearing a pedometer can be very useful in helping people measure how many steps per day they are walking, and thus can help them keep track of their current energy expenditure and set goals. Based on currently available research, Tudor-Locke and Bassett (2004) have suggested guidelines for how many steps per day are necessary to maintain an active lifestyle. Less than 5,000 steps per day is considered sedentary, 5,000-7,499 steps per day is considered low active, 7,500-9,999 steps per day is considered somewhat active, more than 10,000 steps per day is considered active, and anything more than 12,500 steps per day is considered highly active. Sisson, Camhi, Tudor-Locke, Johnson, and Katzmarzyk (2012) conducted a study to estimate how many people are walking the recommended 10,000 steps per day to lead a healthy and active lifestyle. In this study 3,744 participants wore an Actigraph AM-7164 pedometer for 7 days. Based on the week of data collection, 36.1% of participants were considered sedentary (less than 5,000 steps per day), 47.6% of participants were classified as low or somewhat active (5,000 – 9,999 steps per day) and only 16.3% of participants were considered active (10,000 steps per day or more).

To study how increasing one's steps per day incrementally to reach 10,000 steps per day would affect health measures, Schneider, Bassett, Thompson, Pronk, and Bielak (2006) had 38 participants wear a pedometer for 36 weeks. Instead of instructing sedentary participants to suddenly walk 10,000 steps a day, after a two week baseline researchers instructed participants to walk at least 7,000 steps per day for the first week of the intervention, 8,000 steps or more a day for the second week, 9,000 steps or more a day for the third week, and finally 10,000 steps per day or more for the remainder of the study. Of the 38 participants in the study, only 19 of them succeeded at following this prescription of walking. Researchers found although all participants significantly increased their steps per day compared to baseline, only those who adhered to the prescription experienced significant improvements in health measures. These participants displayed decreased weight, decreased BMI, decreased percentage of body fat, decreased fat mass, decreased waist circumference, decreased hip circumference, and an improvement in high-density lipoprotein. This suggests suddenly accumulating 10,000 steps per day is not necessary, but working up to that goal and maintaining 10,000 steps per day can lead to significant health improvements.

In recent years there has been a growing body of research in pedometer use as a way to measure energy expenditure and help with weight loss. One such study was conducted by Tudor-Locke, Ainsworth, Whitt, Thompson, Addy, and Jones (2001). In this study 109 participants wore pedometers for 21 days to determine what relationships, if any, existed between physical activity measured as steps per day and body composition variables of weight, BMI, and percentage body fat. Participants recorded their pedometer readings daily in an activity log that was turned in to the researchers. Researchers found participants who recorded walking more steps per day during the study had lower BMIs and percentages of body fat while obese participants recorded walking fewer steps per day.

Pedometers can be useful by providing direct feedback and helping individuals self-monitor and objectively measure their energy expenditure. Simply wearing a pedometer has not been shown to increase participant reactivity and steps per day (Matevey, Rogers, Dawson, & Tudor-Locke, 2006). McMurdo et al. (2010) conducted research to examine the effectiveness of pairing pedometer wearing with a behavior change intervention group in sedentary older women. Researchers found that while simply wearing a pedometer was not sufficient to increase steps per day and physical activity, when combined with a goal setting program pedometers can be quite effective in increasing physical activity. Normand (2008) conducted a study in which four participants wore pedometers and were given goals to increase their daily step counts. Participants received feedback from the researcher that ranged from praise for reaching their goals to encouragement to put forth more effort if they did not reach their step count goals. Results showed that throughout the study participants maintained their weight; however, the study was relatively brief.

Normand's study did find that three of the participants increased their daily step counts, suggesting his prescription of self-monitoring, goal-setting, and feedback can be an effective way to increase steps per day and physical activity.

One way to increase the likelihood of meeting goals is by reinforcing the target behavior. Positive reinforcement occurs when a stimulus is presented after the target behavior and that behavior increases (Pierce and Cheney, 2008). Numerous studies have been conducted examining exercising behaviors and reinforcement. Petry, Andrade, Barry, and Byrne (2013) used a lottery system to reinforce older adults for meeting daily step count goals throughout the 12 week study. Participants in the control group wore pedometers for the duration of the 12 week study and were encouraged to walk at least 6,000 steps per day for the first week, at least 8,000 steps per day in the second week, and at least 10,000 steps per day during the third week and throughout the remainder of the study. Researchers congratulated participants when they met their step count goals and encouraged them to problem solve when they did not meet their step count goals. Participants in the intervention group had the same criteria for step counts, but also received tickets from a prize bowl for a lottery when they met their step count goals. With the lottery, participants could receive either small ticket items that were worth $1, such as water bottles, or large ticket items that were worth $20, such as gift cards. There was also one jumbo ticket item worth $100. While all participants in the study increased their steps per day, the participants who received lottery draws as reinforcement showed a greater increase in steps per day. Participants in the lottery group also demonstrated improvements in other health measurements, namely a decrease in blood pressure, decreased weight, decreased weight circumference, increased distance walked during a six minute walking test, and decreased time in a sit to stand test. This study suggests using reinforcement can help people increase their walking activity, which can potentially improve other ambulatory and health factors.

Exercise programs that utilize monetary reinforcement as incentives are effective in increasing exercise behavior; however, the results are usually short-term (Strohacker, Gallaraga, and Williams, 2014). Follow-up results are mixed depending on the schedule of reinforcement and the specific incentives used. This was demonstrated in a study by Strohacker, Galarraga, Emerson, Fricchione, Lohse, and Williams (2015). Researchers utilized small monetary reinforcement instead of a lottery system as an incentive for university students to exercise. All participants were instructed to engage in at least 30 minutes of exercise five days per week and received $10 at the end of the study for participation. Participants in the treatment group received an additional $0.01 per every 4 kilocalories expended with the potential to earn a maximum of $5.00 per week for 2000 kilocalories expended. After controlling for BMI, researchers found participants in the treatment group who received additional money for exercising engaged in significantly more calorie expenditure than participants in the control group who did not earn extra money for exercising. However, throughout the course of the study and at follow up, all participants decreased their calorie expenditure, regardless of treatment condition. Researchers suggest the decrease in calorie expenditure could be due to the university student participants experiencing increasing academic demands as the semester progressed, or a loss of interest in the small monetary compensation. Strohacker et al. suggested future research employ loss aversion or negative reinforcement in order to further study the effects of reinforcement on exercise. One way to employ loss aversion is to have participants provide their own money upfront, and instead of earning money for reaching the exercise goals given, they would not lose money for reaching the goals. Conversely, if participants did not reach the designated goals, they would lose increments of their money.

Loss Aversion

Loss aversion is a principle in behavioral economics that is rooted in prospect theory. The theory asserts that the possibility of losing something is twice as aversive as the reinforcive value of gaining something (Kahneman and Tversky, 1979). Based on this principle, an individual would be more likely to engage in a behavior to prevent losing money, rather than engaging in the same behavior to gain the same amount of money. This principle has been demonstrated in a study by Fryer, Levitt, List, and Sadoff (2012). In this study, participants were 150 teachers who were randomly assigned to one of four treatment conditions. In one condition, teachers received monetary reinforcement at the end of their school year for their students' performance on an end of the year assessment. In a second condition, teachers were given the monetary incentive upfront and signed a contract agreeing to pay the money back if their students' performance on the end of the year assessment was not satisfactory. The third and fourth conditions were the same as the first two conditions, with the exception that the teachers were placed in teams and their monetary compensation was dependent on the performance of all the teachers' students in the team, rather than just the teacher's own students. Researchers found the teachers who were given the monetary compensation upfront, or the loss aversion condition, had students with higher scores on the end of the year assessment compared to students with teachers who received monetary compensation at the end of the year. Furthermore, teachers in the loss aversion team condition had students with the highest test scores. This study suggests loss aversion can be a powerful incentive for performance. In loss aversion, there is the threat of losing something. This threat can be viewed as negative reinforcement. Negative reinforcement is when an aversive stimulus is removed as a consequence of a specific behavior and that behavior increases in the future (Pierce and Cheney, 2008).

Fitness Trackers

Although quite a bit of research utilizing pedometers has been conducted, there is even a smaller subset of research that has been conducted utilizing smart pedometers or watches. Recently there has been a surge in consumer level wearable smart pedometers called fitness trackers. Current data show one in six American consumers owns and uses a fitness tracker (Piwek, Ellis, Andrews, and Joinson, 2016). These newer pedometers are worn on the wrist and have more features than just counting steps. For example, the Fitbit Flex tracks steps walked, distance traveled, calories burned, minutes engaged in activity, minutes engaged in no activity, and even quality of sleep (Fitbit Inc., 2016).

Most research on pedometers has utilized specific models that have been tested and proven to be the most accurate at counting steps (VanWormer, 2004; Noah, Spierer, and Bronner, 2013; Visovsky, Kip, Rice, Hardwick, and Hall, 2013). Although the new generation of smart pedometers and watches are more sensitive, the location of the device may affect the data. All traditional pedometers and smart pedometers differ in accuracy and may over or under report actual steps taken (Melanson et al., 2004). The Actigraph accelerometer has been used in many studies and is often used as a reference due to its high validity. Alharbi, Bauman, Neubeck, and Gallagher (2016) conducted a study to compare the Actigraph and the Fitbit Flex. Participants wore a Fitbit Flex and Actigraph simultaneously to compare step counts and measures of activity. Researchers found there was a strong correlation between the Fitbit Flex and Actigraph in measuring step counts; however, as the number of steps increased, the Fitbit Flex tended to overestimate step counts compared to the Actigraph. Despite its tendency to over report steps walked, the Fitbit has been shown to be reasonably accurate and reliable in counting steps (Noah, Spierer, and Bronner, 2013).

Given the limited research on popular wearable smart accelerometers, the current study seeks to examine whether a Fitbit Flex coupled with goal setting and negative reinforcement can assist participants in increasing their steps per day. Strochacker et al. (2015) suggested future research be conducted to examine the effect of loss aversion on exercise. The current study will utilize loss aversion by having participants lose money if they do not reach their step count goals. The current study will also utilize negative reinforcement by presenting participants with a warning that they will lose money if they do not meet their daily step count goals. In this case, the warning will serve as an aversive stimulus that will be removed when participants meet their step count goals.

METHOD

Participants

Three university student participants were recruited through the online SONA system at California State University Stanislaus. It was necessary that participants have access to a smart phone or computer to upload data from a Fitbit. Participants were required to be currently inactive and yet physically healthy enough to walk and engage in a program to increase walking. Participants were excluded if they were currently participating in any other weight loss or exercise programs. Participants were also required to be able and willing to participate for the entire length of the study (approximately one month). Participants were treated according to the ethical standards of the American Psychological Association and read and signed an informed consent. Participants were comprised of three females ages 18 to 33 years old.

Experimental Design

A multiple baselines across participants combined with an ABA reversal design was used. During the ABA reversal participants experienced baseline, the intervention, and a return to baseline for follow up. The first participant was in the baseline phase for three days. The second participant was in the baseline phase for five days, and the third participant was in the baseline phase for seven days. Participants were in the treatment condition for 12 days before returning to baseline conditions for five days. This design allowed the researcher to determine whether goal setting coupled with the threat of losing money would have either a short term or long term effect on increasing walking. The independent variable was wearing the Fitbit Flex for self-monitoring, receiving a goal from the researcher to increase their steps per day by 10% from the average of the previous two days, and either maintaining their monetary reinforcement for meeting their goals or losing $8 each day they did not meet their goals. The dependent variables were steps per day and weight.

Setting and Materials

The researcher met with participants in an empty classroom, except on holidays and weekends when meetings were held outside the psychology building at California State University Stanislaus. Throughout the study participants wore a Fitbit Flex pedometer (Fitbit Inc., 2017). The Fitbit Flex does not display the number of steps walked on the display screen, but has five small round lights that serve as feedback to let the wearer know his or her progress towards his or her step count goal. For example, when the wearer reaches his or her goal, all five lights are lit up on the display screen. The Fitbit Flex uses bluetooth to automatically upload data to the wearer's smartphone, and the device itself holds daily total data for 30 days. Participants were free to choose where they walked and accumulated step counts. For instance, participants could walk outside, indoors, or on a treadmill.

Procedure

Participants attended an initial training with the researcher at the beginning of the study. During the training participants read and signed an informed consent and were given a Fitbit Flex. The researcher taught participants how to use the Fitbit Flex. Participants were instructed to wear their Fitbits each day and to only remove them for showering, water activities such as swimming, and at night to charge the battery. In order to measure any changes in weight throughout the duration of the study, participants were weighed four times. Participants were weighed at the initial training which was the start of the baseline phase, at the end of the baseline phase, at the end of the treatment phase, and at the end of the return to baseline phase. Participants were weighed on the same scale each time and wore the same or similar types of clothing. To control for activity the pedometer might not record, such as swimming or bicycling, or changes in eating habits throughout the study, the researcher texted a short questionnaire to participants at the end of each day at 10:00 pm. The questionnaire stated, "Did you engage in any physical activity today for 10 or more minutes that increased your heart rate and breathing? If so, what was it? Do you feel you have consumed your normal diet today? If you ate more than normal, what was it (i.e. pizza, ice cream sundae)?" During the baseline and return to baseline phases, the researcher texted each participant at 8:00 am to remind them to put on and wear their Fitbit Flexes for the day, and at 10:00 pm to ask about any changes in activity or diet for the day. During the intervention phase the researcher continued to text participants at 8:00 am and 10:00 pm, but the 8:00 am text included the participants' individualized step count goals for the day and the warning of losing $8 for not reaching their step count goals. The 10:00 pm text included the step count goal for the next day, and the same warning of losing $8.

During the baseline phase participants wore the Fitbit Flexes. The researcher had previously set up each participant's Fitbit Flex with a step count goal of 150,000 steps per day. This ensured the lights on the Fitbit would not show the participants' progress in accumulating steps during any of the phases. The researcher met with each participant individually at the start of the intervention phase to collect the stored baseline data on the Fitbit Flex, and to help the participant sync the device with her smart phone. During this one-on-one meeting, the researcher explained to each participant the monetary policy. The participants' goals were to increase their steps by 10% compared to the average step counts of the previous two days. The goals were calculated by the researcher. Participants lost $8 from their lump sum of $96 each day they did not meet their step count goals. The researcher notified participants each day at 10:00 pm if they lost money for not reaching their step count goals. If participants reached their daily step count goals, the researcher notified them they did not lose $8 that day for reaching their goals. During the intervention and return to baseline phases, participants texted a screenshot of their step counts to the researcher at 10:00 pm. Throughout the treatment phase participants wore the Fitbit Flex and had access to their respective profiles on their smartphones and thus step count data. Participants continued to have access to their step counts during the return to baseline phase as the devices were already synced to their phones.

At the end of the study participants attended a debriefing meeting with the researcher. During the final meeting participants returned their Fitbit Flex pedometers and took a social validity questionnaire. Participants received any money they had earned for reaching their step count goals and an additional $17 for completing the study. Participants had the opportunity to earn a maximum of $113.

Interobserver Agreement and Treatment Validity

A second independent observer was present for all the meetings with participants. During both the initial training at the beginning of the study and the one-on-one trainings at the beginning of the intervention phase, the independent observer completed a checklist. The checklist delineated all the steps the researcher needed to complete in each meeting. As the researcher completed each step, the independent observer would check the item off the list. If the researcher did not complete an item on the list, that item was not checked off the list. Treatment validity was measured by calculating the percentage of items the researcher completed on the checklist.

During the four weigh-ins the independent observer and researcher would record the participants' weights as displayed on the scale. An independent observer reviewed all texts sent to participants throughout the study to ensure the researcher sent all texts at the correct times and included all the criteria. The independent observer also reviewed texts to verify each participant's daily step counts throughout the study. Interobserver agreement was measured by calculating the percentage of corresponding agreements between the independent observer and the researcher on the participants' weights, the participants' daily step counts, and the items on the checklist.

The independent observer checked each item off the list during each of the initial four meetings with participants (the initial meeting with all three participants at the beginning of the baseline phase, and at the end of the baseline phase when the researcher met with participants individually) implicating the researcher completed all necessary steps and both treatment validity and interobserver agreement for these meetings was 100%. An independent observer also checked texts between participants and the researcher and verified the participants' weight at each weigh in. On the twelfth day of the study (Grace's ninth day of the intervention phase, Paige's seventh day of the intervention phase, and Amanda's third day of the intervention phase), the researcher did not send the 8:00 am text until 11:15 am. On the eighteenth day of the study (Grace's third day of the return to baseline phase, Paige's first day of the return to baseline phase, and Amanda's ninth day of the intervention phase), the participants did not receive the 8:00 am text. Interobserver agreement for the text messages was 100% and treatment validity for the texts was 90%. Interobserver agreement was 100% for the participants' weights at each weigh in.

RESULTS

Figure 1 shows the data for each participant's step counts throughout the phases of the study. Grace was the least active of the three participants with an average of 2,991 steps in the last two days of the baseline phase. Paige was the most active participant with an average of 6,874 steps on the last two days of baseline. Amanda had an average of 6,666 steps on the two days in which she was in the baseline condition. All three participants increased their steps enough to exceed the recommended 10,000 steps per day. Grace's step count goal at the end of the intervention phase was 10,611 steps per day. Paige's goal at the end of the intervention phase was 16,671 steps, and Amanda's goal was 12,190 steps per day. The last two days of the return to baseline phase Grace averaged only 2,141 steps per day, which was slightly lower than her average of the last two days during the baseline phase. Paige averaged 7,833 steps per day on the last two days of the return to baseline phase, which was 959 steps more than her average on the last two days of the baseline phase. Amanda averaged 7,337 steps per day on the last two days of the return to baseline phase, which was 671 steps more than her average on the two days in the baseline phase.

Table 1 displays the weight for each participant at each of the four meetings with the researcher. Grace had a starting weight of 117.2 pounds and a BMI of 22.1. At the second and third meetings with the researcher, she weighed 118 pounds. By the end of the study Grace again weighed 117.2 pounds. Paige weighed 121.4 pounds at the beginning of the study. At the end of the baseline phase she weighed 127.6 pounds. During the treatment phase she lost 5 pounds, but still weighed 1.2 pounds more than her initial weight at the beginning of the baseline phase. By the end of the study, she weighed 124.2 pounds. Paige's BMI was 22.9 at the beginning of the study and 23.5 at the end of the study. Amanda weighed 170.4 pounds with a BMI of 25.2 at the beginning of the study. She gained 0.6 pound during the baseline phase and 1.8 pounds during the intervention phase. She weighed 169.2 pounds with a BMI of 25 at the end of the study. Amanda was the only participant with a BMI classified as "overweight" (body mass index of 25 or higher), while Grace and Paige both were considered normal weights relative to their heights.

Grace was the only participant to reach her step count goal every day during the intervention phase and to receive the full amount of $96. Paige did not reach her step count goals on the fifth and eleventh days of the intervention phase and earned $80. Amanda earned $88 for meeting her step count goals on all except the eighth day of the intervention phase when she reported she forgot to check her steps that day and was 1,978 steps short of her goal. All three participants earned an additional $17 for completing the study.

Grace reported engaging in 10 or more minutes of activity that raised her heart rate and breathing eight out of the twelve days of the intervention. She did not report engaging in any extra activity any of the days during the baseline and return to baseline phases. She reported eating more than her normal diet on the second day of the baseline phase (nachos and popcorn at the movies) and on the last day of the return to baseline phase (French fries). Paige reported she consumed a normal diet during every day of the study, except for the second day of the baseline phase in which she reported she ate more tacos than she normally does. She reported engaging in extra activity on only three days of the entire study. On the third day of the baseline phase and the tenth day of the intervention phase she went hiking, and on the second day of the baseline phase she went jogging. Amanda reported engaging in 10 or more minutes of activity that increased her heart rate and breathing eleven out of the twelve days of the intervention phase. On the first day of the baseline phase she reported she went swimming recreationally. She also reported engaging in extra activity on the first day of the return to baseline phase when she walked a little bit, and on the third day of the return to baseline phase when she reported she walked a lot between classes. She reported consuming more than her normal diet on the second day of the baseline phase, the fifth day of the intervention phase, and the first and third days of the return to baseline phase when she ate ice cream and cake.

Social Validity

At the final meeting all three participants completed a social validity questionnaire. All three participants reported they felt wearing the Fitbit Flex was an easy any way to measure how many steps they walked each day. Paige and Amanda strongly agreed with the statement that their step count goals were reasonable to accomplish each day, while Grace agreed with this statement. Grace and Amanda strongly agreed that losing $8 each day for not reaching their step count goals was effective in motivating them to walk more, while Paige agreed with this statement.

Grace and Paige agreed they would probably continue to wear a Fitbit or similar fitness tracker to monitor their exercise after the completion of the study, while Amanda strongly agreed. The last statement on the social validity questionnaire stated "After this study I will continue to strive to walk more each day even without any monetary compensation." Grace neither agreed nor disagreed with the statement, while Paige strongly agreed and Amanda agreed with the statement.

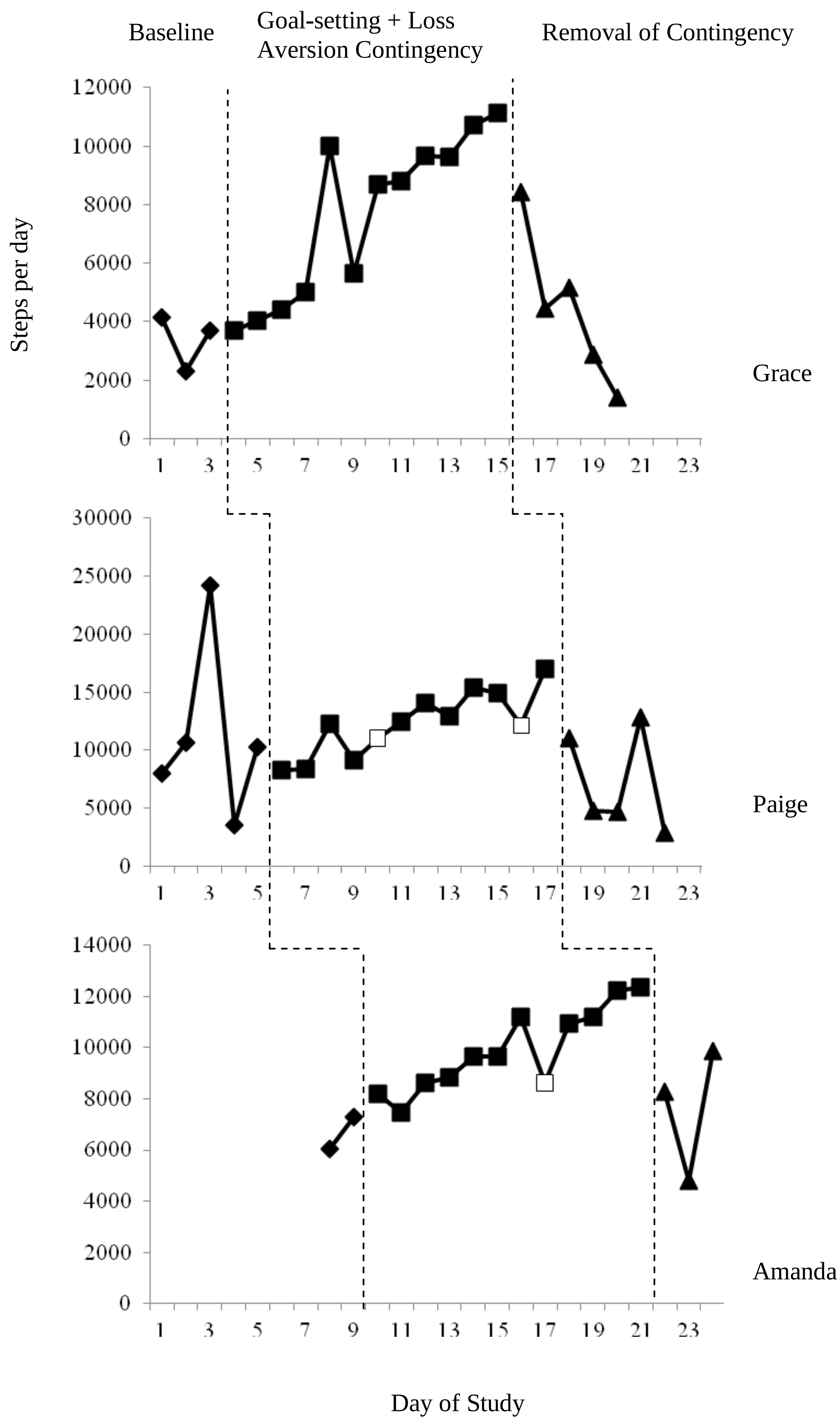

Figure 1. Participants' steps per day during Baseline, Goal-setting + Loss Aversion Contingency, and Removal of Contingency phases. Outlined data points are days the participants did not reach their step count goals.

Table 1

Participants' Weights and Body Mass Indexes at Each Weigh In

	Meeting 1 Weight/BMI	Meeting 2	Meeting 3	Meeting 4
Grace	117.2/22.1	118/22.3	118/22.3	117.2/22.1
Paige	121.4/22.9	127.6/24.1	122.6/23.2	124.2/23.5
Amanda	170.4/25.2	171/25.3	172.8/25.5	169.6/25

DISCUSSION

All three participants increased their steps during the intervention phase relative to the baseline and return to baseline phases. Although they each had different step count goals, all three participants' graphs show the expected increasing trend during the intervention phase. Grace's data during the return to baseline phase demonstrated a rapid decreasing trend. Paige's data during the baseline and return to baseline phases were more variable. On the third day of the baseline phase she went hiking and walked 24,189 steps. Amanda had an increasing trend during the baseline phase, but only had two days of baseline data due to a malfunction with the Fitbit Flex. Amanda only had three days in the return to baseline phase. Her step counts in the return to baseline phase were slightly higher than her step counts in the baseline phase, but still decreased relative to her increasing trend in the intervention phase.

Like the participants in Schneider, Bassett, Thompson, Pronk, and Bielak's (2006) study, the participants in the present study were successful in incrementally increasing their steps per day. By the end of the intervention phase, all three participants reached or exceeded the goal of 10,000 steps per day to lead an active life as delineated by Tudor-Locke and Bassett (2004). Paige's goal at the end of the intervention phase was 16,671 steps per day which is more than 12,500 steps per day and would be classified as highly active. Amanda's goal at the end of the intervention phase approached the classification of highly active at 12,190 steps per day.

Just as in Normand's research (2008), the present study was relatively brief yet showed pedometers can be useful tools to help individuals walk more when paired with goal-setting. In Normand's study, although three of the four participants were successful in increasing their steps per day, they maintained their weight throughout the study. The present study had the same findings. Participants became much more active during the intervention phase, but did not experience or maintain any substantial weight loss. Based on research conducted by Strohacker, Gallaraga, and Williams (2014), it was expected any progress participants made in increasing steps per day would be short-lived. The return to baseline phase data shows participants basically returned to their baseline levels of walking.

Fryer, Levitt, List, and Sadoff (2012) successfully demonstrated how the principle of loss aversion could motivate teachers to improve students' end of the year assessment scores. The present study sought to take Strohacker et al.'s suggestion to examine how loss aversion could affect exercise behavior. Overall, loss aversion seems to have successfully motivated the participants to increase their steps per day during the intervention phase. As expected, once the independent variable of losing money was removed, the participants returned to baseline levels of walking. Research by Matevey, Rogers, Dawson, and Tudor-Locke (2006) suggests simply wearing a pedometer is not enough to increase walking, and the present study also found the same effect. Overall, when paired with goal setting, loss aversion in the form of losing money for not reaching increasing step count goals, and negative reinforcement in the form of a threat to lose money, wearing the Fitbit Flex seems to be effective at increasing steps per day to a more active level of physical activity. While the prescription of self-monitoring, goal-setting, loss aversion, and negative reinforcement was successful, it only works as long as a second person is available to hold accountable the person wearing the pedometer. Once the components of goal-setting, loss aversion, and negative reinforcement were removed, the participants' steps per day decreased to baseline levels.

There are several limitations in this particular study. One major limitation is Amanda's shortened baseline phase. At the second meeting with Amanda at the end of the baseline phase, the researcher discovered the Fitbit Flex had not recorded any of Amanda's step count data for the duration of the seven days of the baseline phase. In order to set Amanda's goal of a 10% increase of the average of the previous two days' step counts, the researcher made sure the Fitbit Flex was working and synced with Amanda's phone. Amanda then completed two days of the baseline phase with no goal. Because there were seven days of no data, Amanda had reduced baseline and return to baseline phases (two and three days, respectively, versus the expected seven and five days). This means that although the study was designed to be a multiple baselines across participants combined with an ABA reversal, some of the benefits of this type of design were missing.

One purpose of a multiple baselines across participants design was for the participants to act as controls for both themselves and each other. Amanda's two days of baseline data do not coincide with Grace or Paige's baseline data which means she unfortunately does not serve as a control for either of the other two participants. Another downside is that Amanda's baseline data show an increasing trend, and thus one might argue the data during the intervention phase is not independent of the data of the baseline phase and might have increased without the intervention being implemented. Unfortunately, this is a potential downside of technology. With traditional pedometers, the step counts are always displayed on the pedometer. With wearable fitness trackers, they require periodic charging and may not sync with phones or computers. Although the Fitbit Flex can hold 30 days' worth of step count data and appeared to be working properly at the beginning of the study, it did not record any steps and there was no way to check as it was not yet synced with Amanda's smart phone.

Another limitation is that although the purpose of the study was to examine how loss aversion could motivate overweight individuals to increase their walking to the recommended 10,000 steps per day, only one of the participants was considered overweight. Amanda had a BMI between 25 and 25.5 throughout the study which is considered overweight. Grace and Paige had body mass indexes below 25 and were considered normal weight. The study was conducted during the summer semester and students were not readily available to participate, making it harder to find participants that were classified as overweight. The researcher did not measure the participants' heights and calculated their body mass indexes based on the participants' self-report of their heights. Although the same scale was used each time, it was a scale marketed for home use and not a medical grade scale.

In order to control for unexpected higher step counts and to explain any possible extraneous weight loss or gain, the researcher texted participants each night about their activity and diet. The participants' responses were self-report and not objective measures of their actual caloric intake. The texts did help explain, however, Paige's higher step count of 24,189 steps on the third day of the baseline phase. It is interesting to note Paige was the most active participant with the highest step count goals and besides two days when she went hiking and one day when she went jogging, she reported no extra exercise throughout the study. According to Paige's step count data, she increased her walking to meet her goals, but perhaps she did not feel she had exerted herself much as she was already fairly active.

Paige was more active than expected. On the tenth day of the intervention phase, the researcher checked in with Paige via text messaging. Her final step count goal was 16,671 steps per day. The researcher asked Paige if she was feeling well physically and reminded her to cease exercise and contact the researcher if she experienced any adverse effects from the increased physical activity. Paige reported feeling perfectly fine and capable of continuing the study. Future research can pre-determine that participants are truly inactive by having them wear a fitness tracker before the experimental study. Without wearing a pedometer or fitness tracker, individuals may over or under estimate how active they are.

Future research should utilize overweight and obese participants and conduct longer studies to see if prolonged intervention phases would lead to more weight loss. The present study was relatively brief and did not demonstrate any real weight loss when normal day to day fluctuations in weight are taken into account. Longer baseline and return to baseline phases could also better demonstrate trends of walking without the intervention. A component analysis could be beneficial in determining which component of the present study is most effective at increasing and maintaining walking more steps per day.

REFERENCES

REFERENCES

Alharbi, M., Bauman, A., Neubeck, L., & Gallagher, R. (2016). Validation of Fitbit Flex as a measure of free-living physical activity in a community-based phase III cardiac rehabilitation population. *European Journal of Preventive Cardiology, 23*(14), 1476-1485. doi: 10.1177/2047487316634883

Centers for Disease Control and Prevention (CDC). (2016, June 16). Defining adult overweight and obesity. (2016, June 16). Retrieved from https://www.cdc.gov/obesity/adult/defining.html

Finkelstein, E. A., Trogdon, J. G., Cohen, J. W., & Dietz, W. (2009). Annual medical spending attributable to obesity: Payer-and service-specific estimates. *Health Affairs, 28*(5), 822-831. doi: 10.1377/hlthaff.28.5.w822

Flegal, K. M., Carroll, M. D., Kit, B. K., & Ogden C. L. (2012). Prevalence of obesity and trends in the distribution of body mass index among U. S. adults 1999-2010. *Journal of the American Medical Association, 307*(5), 491-497.

Fryer, R. G., Levitt, S. D., List, J., & Sadoff, S. (2012). Enhancing the efficacy of teacher incentives through loss aversion: A field experiment. *NBER Working Paper No. 18237*.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*, 263-291.

Matevey, C., Rogers, L. Q., Dawson, E., and Tudor-Locke, C. (2006). Lack of reactivity during pedometer self-monitoring in adults. *Measurement in*

Physical Education and Exercise Science, 10(1), 1-11.

McMurdo, J. E. T., Sugden, J., Argo, I., Boyle, P., Johnston, D. W., Sniehotta, F. F., & Donnan, P.T. (2010). Do pedometers increase physical activity in sedentary older women? A randomized controlled trial. *Journal of the American Geriatrics Society, 58*(11), 2099-2106. doi:10.1111/j.1532-5415.2010.03127

Melanson, E. L., Knoll, J. R., Bell, M. L., Donahoo, W. T., Hill, J. O., Nysse, L. J., Lanningham Foster, L., Peters, J. C., & Levine, J. A. (2004). Commercially available pedometers: Considerations for accurate step counting. *Preventive Medicine*, *39*(2), 361-368. doi:10.1016/j.ypmed.2004.01.032

National Heart Lung and Blood Institute (NHLBI). (2017, February). Overweight and obesity causes. Retrieved from https://www.nhlbi.nih.gov/health/healthtopics/topics/obe/causes

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). (2012, October). Overweight and obesity statistics. Retrieved from https://www.niddk.nih.gov/healthinformation/healthstatistics/Pages/overweightobesity-statistics.aspx

Nielsen. (2014, March 3). Tech-styles: Are consumers really interested in wearing tech on their sleeves? *Nielsen's Connected Life Report*. Retrieved from http://www.nielsen.com/us/en/insights/news/2014/tech-styles-are-consumers-really-interested-in-wearing-tech-on-their-sleeves.html

Noah, A., Spierer, D. K., & Bronner, S. (2013). Comparison of steps and energy expenditure assessment in adults of Fitbit Trackers and Ultra to the Actical and indirect calorimety. *Journal of Medical Engineering and Technology, 37*(7), 456-462. doi:10.3109/03091902.2013.831135

Normand, M. P. (2008). Increasing physical activity through self-monitoring, goal setting, and feedback. *Behavioral Interventions, 23*, 227-236. doi: 10.1002/bin.267

Ogden, C. L., Carroll, M. D., Fryar, C. D., Flegal, K. M. (2015). Prevalence of obesity among adults and youth: United States, 2011-2014, *NCHS Data Brief, 219*.

Petry, N. M., Andrade, L. F., Barry D., & Byrne, S. (2013). A randomized study of Reinforcing ambulatory exercise in older adults. *Psychology and Aging, 28*(4), 1164-1173. doi:10.1037/a0032563

Pierce, W. D. & Cheney, C. D. (2008). *Behavior analysis and learning fourth edition*. New York,NY: Psychology Press.

Piwek, L., Ellis, D. A., Andrews, S., & Joinson, A. (2016). The rise of consumer health wearables: Promises and barriers. *PLoS Med, 13*(2): e1001953

Schneider, P. L., Bassett, D. R., Thompson, D. L., Pronk, N. P., & Bielak, K. M. (2006). Effects of a 10,000 steps per day goal in overweight adults. *American Journal of Health Promotion, 21*(2), 85-89.

Sisson, S. B., Camhi, S. M., Tudor-Locke, C., Johnson, W. D., & Katzmarzyk, P. T.

(2012). Characteristics of step-defined physical activity categories in U.S. adults. *American Journal of Health Promotion, 26*(3), 152-159. doi:10.4278/ajhp.100326-QUAN-95

Strohacker, K., Galarraga, O., Emerson, J., Fricchione, S. R., Lohse, M., & Williams, D. M. (2015). Impact of small monetary incentives on exercise in university students. *American Journal Of Health Behavior, 39*(6), 779-786. doi:10.5993/AJHB.39.6.5

Strohacker, K., Galarraga, O., & Williams, D. M. (2014). The impact of incentives on exercise behavior: A systematic review of randomized controlled trials. *Annals of Behavioral Medicine, 48*(1), 92-99. doi:10.1007/s12160-013-9577-4

Tudor-Locke, C., Ainsworth, B. E., Whitt, M. C., Thompson, R. W., Addy, C., L., & Jones, D. A. (2001). The relationship between pedometer-determined ambulatory activity and body composition variables. *International Journal of Obesity, 25*, 1571-1578.

Tudor-Locke, C., & Bassett, D. R. (2004). How many steps per day are enough? Preliminary pedometer indices for public health. *Sports Medicine, 34*(1), 1-8. doi:10.2165/00007256200434010-00001

VanWormer, J. J. (2004). Pedometers and brief e-counseling: Increasing physical activity for overweight adults. *Journal of Applied Behavior Analysis, 37*(3), 421-425.

Visovsky, C., Kip, K. E., Rice, J. L., Hardwick, M., & Hall, P. (2013). Choosing instruments for research: An evaluation of two activity monitors in healthy women. *Journal of Novel Physiotherapies, 3*: 171. doi:104172/2165-7025.100171

APPENDIX

FITBIT FLEX SOCIAL VALIDITY QUESTIONNAIRE

Please circle a number below to indicate to what extent you agree or disagree with each statement.

1 = I strongly disagree
2 = I disagree
3 = Neutral, I neither disagree nor agree
4 = I agree
5 = I strongly agree

1.) I feel wearing the Fitbit Flex was an easy way to measure how many steps I walked each day.

1 2 3 4 5

2.) I feel the step count goals were reasonable to accomplish each day.

1 2 3 4 5

3.) I feel losing $8 each day for not reaching my step count goals was effective in motivating me to walk more.

1 2 3 4 5

4.) I would continue to wear a Fitbit or similar fitness tracker to monitor my exercise expenditure after the completion of the study.

1 2 3 4 5

5.) After this study I will continue to strive to walk more each day even without any monetary compensation.

1 2 3 4 5