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COMPARING THE EFFECTS OF NEGATIVE REINFORCEMENT CONTRACTS
AND GOAL SETTING ON INCREASING ADULTS' PHYSICAL ACTIVITY

A Thesis

Presented to the faculty of the Department of Psychology

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by

David Alfonso Hernandez

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Abstract
of
COMPARING THE EFFECTS OF NEGATIVE REINFORCEMENT CONTRACTS
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Less than 5% of adults meet the CDC recommendation of 150 minutes of moderate-intensity physical activity per week. Contingencies that promote competing problematic behaviors make it difficult for individuals to engage in healthy behaviors. Thus, strategies in which immediate consequences for healthy behaviors are contrived to compete with problematic contingencies may be effective in increasing behaviors that produce positive cumulative effects. The aim of this study was to compare the effectiveness of negative reinforcement contingency contracts and feedback with a goal setting with feedback intervention. Individualized goals were determined by increasing each participants' average steps during a screening period by a minimum of 20-25% in Experiment 1, and a minimum of 50% in Experiment 2. Results indicated that participants met their daily step goals more often and had higher average daily step counts during the contract condition. These findings support the use of negative reinforcement monetary contracts in physical activity interventions.

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Chapter 1

INTRODUCTION

Reduced amounts of physical activity or sedentary behavior in adults contribute to excess weight gain and an increased likelihood of serious medical conditions, such as cardiovascular disease, type II diabetes, stroke, and some cancers (Centers for Disease Control and Prevention [CDC], 2015; Hill, Wyatt, Reed, & Peters, 2003). For those concerned with their own levels of physical activity, walking is a simple physical activity that most adults can engage in daily without having to look to outside resources (e.g., access to equipment, transportation to and from a fitness center). The American Heart Association recommends adults walk 10,000 steps a day. Previous physical activity research also supports this recommendation and suggests walking 10,000 steps on most days of the week can help reduce the risk of high blood pressure and other preventable health conditions (Haskell et al., 2007; Iwane et al., 2000; Schneider, Bassett, Thompson, Pronk, & Bielak, 2006).

Additionally, the CDC recommends engaging in 150 min of moderate-intensity physical activity (i.e., any activity requiring an exertion level equivalent to a brisk walk) per week (CDC, 2015; Haskell et al., 2007; Kurti & Dallery, 2013). Hill et al., (2003) have also estimated that walking an additional 2000 to 2500 steps per day (compared with a person's daily norm) might be enough to prevent weight gain in an average adult. However, less than an estimated 5% of adults actually meet these recommendations, and

it has been reported that on average, American adults will take approximately half of the recommended steps per day (Bassett, Wyatt, Thompson, Peters, & Hill, 2010; Troiano et al., 2008).

Despite regular physical activity providing many health benefits, a common deficit for American adults is simply not walking enough each day (Haskell et al., 2007; Iwane et al., 2000; Schneider, Bassett, Thompson, Pronk, & Bielak, 2006). Cooper, Heron, and Heward (2007) suggest that many behavioral excesses (e.g., unhealthy snacking, smoking) or deficits in beneficial healthy behaviors (e.g., eating healthy, regular exercise) might be the result of reinforcement traps. Reinforcement traps occur when naturally occurring contingencies promote problematic behaviors and simultaneously make it difficult for individuals to engage in behavior that would benefit them in the long term, such as exercise. Thus, the application of contingency management strategies in which immediate consequences (e.g., money, praise) for healthy behaviors are contrived to compete with problematic competing contingencies, may be effective in increasing behaviors that produce positive cumulative effects (e.g., fitness, healthy weight; Cooper et al., 2007).

Contingency management involves the objective measurement of a target behavior (e.g., step totals) that provides interested individuals opportunities to earn desirable consequences (e.g., money) contingent on meeting a verifiable goal (e.g., 10,000 steps daily). To successfully utilize a contingency management procedure, the behavior in question must be easy to observe, with reinforcement provided contingent on

the behavior being demonstrated, and withheld should the goal not be met (Cooper et al., 2007). Contingency management has successfully addressed other problems associated with competing contingencies, such as reducing consumption of cigarettes and alcohol (Glenn & Dallery, 2007; Kurti & Dallery, 2014; Miller, 1972). More recent physical activity research also suggests that contingency management can be applied to increase the physical activity of adults (Kurti & Dallery, 2013; Normand, 2008; VanWormer, 2004).

Contingency management studies focused on physical activity of adults have utilized self-monitoring (VanWormer, 2004) and self-monitoring plus goal setting and feedback (i.e., performance reviews and descriptive praise; Normand, 2008), both of which resulted in increased physical activity. Contingency management with monetary incentives has also been successful in increasing the physical activity of adults (Irons, Pope, Pierce, Van Patten, & Jarvis, 2013; Kurity & Dallery, 2013; Petry, Andrade, Barry & Byrne, 2013; Washington, Banna & Gibsion, 2014). As an example, Patel et al. (2016) utilized monetary incentives to increase physical activity (i.e., step totals) of adults who were overweight and obese. Participants were randomly assigned to one of four groups: “gain-incentive” group (i.e., \$1.40 earned per daily goal met), “lottery-incentive” group (i.e., chance to earn money if the goal was met and their number drawn), “loss-incentive” (i.e., \$1.40 removed each day goal is not met), and control (i.e., performance feedback only). The authors concluded that monetary incentives framed as “loss” (i.e., response cost) were most effective for meeting activity goals.

Contingency Contracts

A contingency contract (also known as a performance or behavioral contract) is another contingency management strategy for addressing health related behaviors (Cooper et al., 2007). A contingency contract is a document that two or more individuals negotiate that specifies a contingent relationship between the completion of a specified behavior (and criterion level), a specified consequence (e.g., reward or punishment), as well as the time frame of the agreement (Cooper et al., 2007). Contingency contracts must also include how the behavior will be measured, when the behavior must occur, the implementer of the contingency, and signatures from all involved parties. Contracts may also involve various deposits (e.g., money, tangibles) that are returned to the individual contingent on the completion of agreed upon behaviors (Cooper, et al. 2007; Scull, 2013). Contracts have led to meaningful behavior change in the natural environment for various self-management problems, such as improving academic performance (e.g., Newstrom, McLaughlin & Sweeny, 1999; Wilkinson, 2003) and reducing alcohol and cigarette consumption (e.g., Glenn & Dallery, 2007; Miller, 1972).

Contracts and weight loss. Researchers have also used contingency contracts to reduce bodyweight (Aragona, Cassady & Drabman, 1975; Jeffery, Bjornson-Benson, Rosenthal, Kurth & Dunn, 1984; Jeffery, Thompson & Wing, 1978; Mann, 1972; Scull; Wing, Epstein, Marcus & Shapira, 1981). Although successful, repayment was contingent on weight loss rather than specific behaviors that resulted in lost weight in the majority of these investigations. This limitation proved problematic for participants as

some were reported engaging in unsafe behaviors to meet weight loss goals (e.g., use of laxatives, purging) days or hours before scheduled weigh-ins (Mann, 1972). Thus, rather than targeting weight (which is a result of multiple behaviors), an alternative approach is to target specific behaviors that contribute to weight loss, such as exercise.

Contracts and physical activity. Negative reinforcement (i.e., deposit) contracts with repayment based on physical activity have been successful in increasing the physical activity of adults. For example, Wysocki, Hall, Iwata and Riordan (1979) used contingency contracts to encourage physical exercise among college students. At the start of the contract, participants deposited items of personal value that they could earn back contingent on meeting self-selected weekly aerobic point criteria. Aerobic points were converted figures based on the estimated oxygen consumption used when engaged in particular activities (e.g., running), with each activity worth different point values. The experimenters monitored both the observation of other participants and the translation of aerobic point completion. Results indicated that the contracts produced increases in the number of aerobic points earned per week for seven of the eight students.

In another study, Donlin-Washington, McMullen and Devato (2016) utilized a contract with both a negative and positive reinforcement contingency to increase physical activity. Adult participants were given Fitbit® trackers and split into either a control (i.e., no deposit) or matched deposit contract group. Although all participants could earn up to \$50 for meeting step goals, only those in the deposit contract group contributed \$25. A positive reinforcement contingency was also in place in which participants earned \$1.50

per day for meeting goals and received a \$2.65 bonus for doing so for three consecutive days. Almost all participants in this study increased their average daily step counts by at least 2,500 steps compared with baseline; however, there were no differences between the no-deposit and deposit groups.

In sum, of the eight identified studies that utilized contracts to either increase physical activity or reduce the weight of adults, five utilized a negative reinforcement contingency (Jeffery et al., 1978; 1984; Mann, 1972; Wing et al., 1981; Wysocki et al., 1979), and three utilized a combination of both positive and negative reinforcement (Aragona et al., 1975; Scull, 2013; Donlin-Washington et al., 2016). Additionally, weight was a primary dependent measure in five of the eight studies (Aragona et al., 1975; Jeffery et al., 1978; 1984; Mann, 1972; Wing et al., 1981). Of the eight studies, one study (Scull, 2013) investigated using contracts to reduce problematic eating behaviors (i.e., snacking, sugar consumption). However, only two of the eight studies focused on increasing physical activity and used aerobics points (i.e., Wysocki et al., 1979) or step totals (i.e., Donlin-Washington et al., 2016) as dependent variables. Of the studies utilizing contracts to increase the physical activity of adults, none compared the effectiveness of goal setting with feedback alone with contracts utilizing only a negative reinforcement contingency.

As previously mentioned, utilizing weight as a main dependent variable is problematic as weight loss is not only the product of many behaviors, but is not a sufficient measure of health when taken alone (Normand, 2008; Normand, Dallery, &

Ong, 2015). Thus, to better quantify the effects of physical activity (e.g., step totals), researchers have recently used Fitbit® trackers in physical activity research as a measurement alternative (e.g., Donlin-Washington et al., 2016). A Fitbit® tracker is an accelerometer device that turns movement of a body into digital measurements when attached to the body (“How does,” 2015). Fitbit® trackers (e.g., Fitbit One™, Fitbit Ultra™, Fitbit Zip™) have shown high accuracy when calculating the number of steps taken by participants (Gusmer, Bosch, Watkins, Ostrem, & Dengel, 2014; Lee, Kim, & Welk, 2014; Takacs et al., 2013). Thus, future research investigating the efficacy of contingency contracts to increase physical activity should avoid using weight as a primary dependent measure as well as refrain from making repayment contingent on weight loss.

One aim of the present study was to address several limitations in the contract literature by using the frequency of daily step total goals met as a dependent measure and tracking step totals reached using the Fitbit Zip™ device. In addition, Patel et al. (2016) found that “loss” incentives were more effective in increasing physical activity; however, these incentives were not specified in a contract. Thus, the purpose of the present study was to compare the effectiveness of experimenter funded negative reinforcement contingency contracts and feedback with a goal setting and feedback intervention on increasing the physical activity of adults.

Chapter 2

METHOD

Participants and Setting

In total, seven female students (i.e., five in Experiment 1, two in Experiment 2) attending California State University, Sacramento were recruited for this study via a flyer (Appendix A) distributed around campus or through word of mouth. Interested students had to meet inclusion criteria, determined via a questionnaire (Appendix B) and direct screening (described below) to participate. Participants' ages ranged from 25-35 years old. All conditions took place in the participants' natural environment. Participants met with the experimenter for 15min once a week in a Psychology Clinic located on the California State University, Sacramento campus.

Materials

Materials included seven Fitbit Zip™ devices, Fitbit® companion website accounts, study created email accounts, Amazon® gift cards, and a laptop computer. The experimenter used a Fitbit Zip™ to track step totals for several reasons. First, each Fitbit Zip™ has a 3-month replaceable battery that eliminates the need for participants to charge the device. Second, this model of Fitbit® was chosen to reduce the likelihood of participants attempting to increase step totals by unconventional means (e.g., vigorous repeated arm movements), thus providing a more conservative measure. Lastly, the Fitbit Zip™ was used as it clips onto the waistband of most clothing, permitting participants to

freely use their arms without worry of damaging the device. The experimenter checked the Fitbit® devices weekly to ensure they functioned properly, including the correspondence of step totals, checking the devices for water damage and monitoring battery life.

Experimental Design

A non-concurrent multiple baseline design across participants with imbedded reversals (e.g., ABCBCBC) was used to evaluate the effects of negative reinforcement contingency contracts and goal setting on meeting goals per week and average step totals. Condition A represents direct screening, condition B represents the goal setting and feedback condition (Appendix C), and C represents the negative reinforcement contingency contract condition (Appendix D).

Independent Variables

The independent variables included the negative reinforcement contingency contract condition and the goal setting with feedback condition, alternated across weeks.

Negative Reinforcement Contingency Contract. During this condition, the experimenter briefed participants that they begin the week with a credit of \$21 on an Amazon® gift card as reinforcement for meeting daily step goals for that week. Additionally, the contract stated that for every day participants met or exceeded the daily step total goal, they would avoid having \$3 of the \$21 credit immediately removed from the gift card total for that week. Once informed, participants signed the bottom of the contract indicating they understood the contingency in place for the week. At a weekly

meeting, participants received the remaining balance of the \$21 credit in the form of a loaded Amazon® gift card. In addition to monetary compensation, the experimenter provided praise for meeting goals (e.g., Great job meeting your goals!) or encouragement if goals were not met (e.g., You were so close! Keep going!).

Goal Setting and Feedback. During this condition, there was no consequence for not meeting daily step total goals; however, to help eliminate the potential for participant attrition during this condition, the experimenter provided participants with a \$5 gift card for attending weekly meetings with the device.

Response Measurement and Data Collection of the Dependent Variable

The primary dependent measures in this study were both the frequency of goals met per week and daily step totals recorded on the Fitbit Zip™ device. Data were synced to participants' Fitbit® accounts via the primary investigator's wireless sync dongle. To further improve the accuracy of step totals, participant stride length and height data were taken at the intake meeting and used to further calibrate each participant's Fitbit® by entering this information into their Fitbit® accounts. Stride length was calculated by having participants walk a distance of 30ft while taking at least 22 steps and dividing the total distance traveled by the number of steps taken to reach that distance ("How does," 2015). All data gathered were analyzed using visual inspection of line graphs.

Interobserver Agreement

To ensure correspondence with the step total data from Fitbit® accounts and the primary investigator's data on the computer, a second independent observer also

collected step total data from each participant's Fitbit® account for 100% of meeting days across conditions. A participant was scored as having “X” steps by documenting the daily step total data from the Fitbit® account and placing them into an excel file. An agreement was scored if the number of daily step totals documented by the primary investigator for that week exactly matched step totals on the respective Fitbit® account as documented by the secondary observer. Interobserver agreement (IOA) was calculated using the exact agreement method (i.e., by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100), and IOA remained at 100% throughout the study.

Social Validity

Participants completed a brief social validity questionnaire on the final meeting day of the final condition (Appendix E). These data were collected to evaluate whether participants would use contracts for themselves, if they would recommend the use of contracts to others, and whether or not they found the use of contracts helpful after exposure.

Preliminary Procedures and Screening

Students interested in participating had to meet inclusionary criteria on the *Physical Activity Stages of Change Questionnaire* and pass a direct screening portion that followed. The *Physical Activity Stages of Change Questionnaire*, is a four item self-report questionnaire based on *The Stages of Motivational Readiness for Change Model* that categorizes individuals into one of five stages of change (i.e., Pre-contemplation,

Contemplation, Preparation, Action, Maintenance; Marcus, Lewis & President's Council on Physical Fitness and Sports, 2003; Marcus, Rossi, Selby & Abrams, 1992). This questionnaire was used to exclude individuals who did not intend to become more physically active (e.g., walking briskly, jogging, bicycling, swimming) and those who either already engaged in regular physical activity (i.e., 30 min or more of moderate intensity physical activity on most days of the week) or had been regularly active for the past six months. Individuals categorized as being in the Pre-contemplation stage are considered not physically active, and do not intend to become more physically active (Marcus et al., 2003). Participants categorized as being in the Contemplation and Preparation stages are individuals who are either not currently physically active but intend to become more physically active, or those who are physically active but do not engage in recommended levels of regular physical activity, respectively (Marcus et al.). Individuals classified as being in the Action or Maintenance stages are either already engaging in regular physical activity or have been engaging in physical activity for six months, respectively (Marcus et al.).

Once a participant met the questionnaire inclusion criterion (i.e., categorized in the Contemplation and Preparation stages), the primary investigator created a Fitbit® account, recorded the participant's body weight, and calculated stride length. The experimenter then instructed participants to wear the Fitbit® from the time they arose from bed to the time right before they went to sleep for direct screening (see below) and to return on a weekly scheduled meeting day with the device. Participants then added

email accounts to their cellular devices that linked to corresponding Fitbit® accounts and were prompted to wear the device in all conditions via automated email reminders sent each morning.

Direct screening involved wearing an experimenter-provided Fitbit® for seven days to determine if students met inclusionary criteria for participation in the study (i.e., not exceeding 10,000 steps on any day). During direct screening, the experimenter told participants to disregard the feedback feature from the Fitbit Zip™ that may illuminate as they perform throughout the day in addition to displaying step totals. For screening purposes, the step total goal entered into the Fitbit® application was set to the default of 10,000 steps to make it even more clear if prospective participants exceeded screening criteria (i.e., when opening the Fitbit® application green stars appear over days the goal was met). Though participants received feedback from the Fitbit® screen in the form of four gradually illuminating lights, with each illuminated light signaling 25% of the set daily goal is complete, they were not made aware of the goal.

Thus, to be included in the study, participants had to 1) meet the questionnaire criterion on the *Physical Activity Stages of Change Questionnaire* (i.e., scored in Contemplation or Preparation stages), and 2) not exceed 10,000 daily steps during the seven days of direct screening. Participants who met both criteria were instructed to return to the clinic on a scheduled day (e.g., every Friday) for weekly meetings to sync step total data from Fitbit® trackers, have their body weight recorded, and to collect reinforcement (when appropriate) for the remainder of the study. The experimenter also

notified participants at this time that missing two consecutive meetings without extenuating circumstance would result in termination from the study, with both earned and unearned funds for missed weeks forfeited.

Experiment 1 Procedure

During all conditions following direct screening, participants received daily feedback via the Fitbit® tracker (i.e., reaching daily goal via footprint lights, step totals), as well as weekly performance feedback (i.e., vocal feedback and graphic feedback from the Fitbit® website). Following direct screening, the experimenter trained participants to read the feedback from their Fitbit® devices. Once training was completed, the experimenter negotiated daily step total goals with the participants, which were set between 20-25% above their average step total during direct screening. The initial step total goal was held constant across initial goal setting and contract conditions. However, during the final two phases (i.e., goal setting, contract), step total goals were increased to a minimum of 50% above the average step total achieved during direct screening. Each phase was six days in duration, beginning on Saturdays and ending on Thursdays, and experimental conditions (i.e., goal setting and feedback, contract) were alternated every week. Data collected from meeting days was not included in the contract to avoid penalizing participants for not meeting daily goals when scheduled to return on Friday mornings (i.e., less time to reach step goals).

Chapter 3

RESULTS

Five participants completed Experiment 1. Figure 1 depicts the number of goals met per week for Ruby, Weiss, and Blake across direct screening, contingency contract, and goal setting plus feedback conditions in both the 20-25% and 50% step goal criteria phases. Average step counts and daily step totals for Ruby, Weiss, and Blake are depicted in Figures 2 and 3, respectively. Figure 4 depicts the goals met per week for participants Kara and Diana across direct screening, goal setting plus feedback, and contingency contract conditions in both the 20-25% and 50% step goal criteria phases. Average step counts and daily step totals for Kara and Diana are depicted in Figures 5 and 6, respectively.

Ruby

For Ruby, the frequency of goals met per week (top panel of Figure 1) was greater in the contract condition (five goals met during both Weeks 3 and 5) compared to goal setting and feedback (three and five goals met in Weeks 2 and 4, respectively) during the 20-25% goal criteria phases. During the increased 50% goal criteria phases, the frequency of goals met per week decreased across conditions relative to the 20-25% goal criteria phases, and Ruby met three goals in both conditions. In addition, Ruby's average step totals depicted in the top panel of Figure 2 were higher in the contract condition ($M = 6,711$ in Week 3; $M = 8,481$ in Week 5) compared to both baseline ($M = 4,301$) and goal

setting plus feedback ($M = 4,208$ in Week 2; $M = 6,889$ in Week 4) during the 20-25% goal criteria phases. During the 50% goal criteria phases, average step total performance was slightly higher in the goal setting plus feedback condition ($M = 5,658$ in Week 6) than in the contract condition ($M = 5,109$ in Week 7), though the difference was negligible. A decrease in daily step totals was observed in baseline for Ruby (depicted in the top panel of Figure 3), and her daily step totals were variable across conditions and phases, with less variability observed during the 50% goal criteria phases. When compared to baseline, the greatest increase in daily step totals was observed during the 20-25% goal criteria phases. During the increased 50% goal criteria phases, daily step totals decreased across conditions relative to the 20-25% goal criteria phases.

Weiss

For Weiss, the frequency of goals met per week (middle panel of Figure 1) was greater in the contract condition (six goals met during both Weeks 3 and 5) compared to goal setting and feedback (five and four goals met in Weeks 2 and 4 respectively) during the 20-25% goal criteria phases. During the increased 50% goal criteria phase, the number of step goals met per week decreased across conditions relative to the 20-25% goal criteria phase, however the number of goals met in the contract condition (five goals met in Week 7) was notably higher than those met in the goal setting condition (two goals met in Week 6). Average and daily step totals depicted in the middle panels of Figures 2 and 3, respectively, were similar in the contract ($M = 5,164$ in Week 3; $M = 4,891$ in Week 5; $M = 5,619$ in Week 7), and goal setting plus feedback ($M = 4,600$ in Week 2; M

= 4,892 in Week 4; $M = 5,253$ in Week 6) conditions across both goal criteria phases.

Differences in average step totals in baseline ($M = 4,148$) were negligible when compared to experimental conditions, except during the 50% goal criteria phase where there was a slight increase during the contract condition ($M = 5,619$ in Week 7) from baseline. A minor increase in daily step totals from baseline was observed for Weiss (depicted in the middle panel of Figure 3) following the introduction of experimental conditions. Data following the introduction of experimental conditions remained stable across conditions and phases, with the most variability observed in the goal setting and feedback conditions during the 20-25% (Week 4) and 50% goal criteria phase (Week 6). Minor differences in daily step totals between experimental conditions were observed and were found to be negligible during 20-25% goal criteria phases. However, during 50% goal criteria phases, Weiss was found to have higher daily step totals more often in the contract condition.

Blake

For Blake, the frequency of goals met per week (bottom panel of Figure 1) was only slightly greater in the contract condition (two and three goals met in Week 4 and 6 respectively) compared to goal setting and feedback (three and one goals met in Week 3 and 5 respectively) during the 20-25% goal criteria phases. However, during the increased 50% goal criteria phase, the number of step goals met per week notably increased in the contract condition (five goals met in Week 8) relative to goal setting and feedback (three goals met in Week 7). Average step totals depicted in the bottom panel of

Figure 2 when compared to average step total performance in baseline ($M = 3,723$ in Week 1; $M = 4,111$ in Week 2), average step totals were higher in the contract conditions during the 20-25% goal criteria phases. Average step totals were greater in the contract condition ($M = 4,264$ in Week 4; $M = 5,854$ in Week 6) relative to the goal setting and feedback condition ($M = 3,695$ in Week 3; $M = 2,036$ in Week 5) during the 20-25% goal criteria phase. During the 50% goal criteria phase, average step total performance was slightly higher in the goal setting plus feedback condition ($M = 5,778$ in Week 7) relative to the contract condition ($M = 5,217$ in Week 8). For Blake, daily step totals are depicted in the bottom panel of Figure 3. Daily step totals when compared to baseline were negligible across goal setting and feedback conditions in the 20-25% goal criteria phases. However, although variable, the highest daily step totals were reached during the contract conditions and subsequently decreased following returning to goal setting plus feedback conditions during 20-25% goal criteria phases. Blake's daily step totals were further increased during the 50% goal criteria phases when compared to baseline. During the increased 50% goal criteria phases, daily step totals increased across conditions relative to the 20-25% goal criteria phases, with greater daily step totals achieved in the goal setting plus feedback condition. Her daily step totals were observed to be variable across conditions and phases, with the most variability observed in the contract conditions during the 20-25% goal criteria phases.

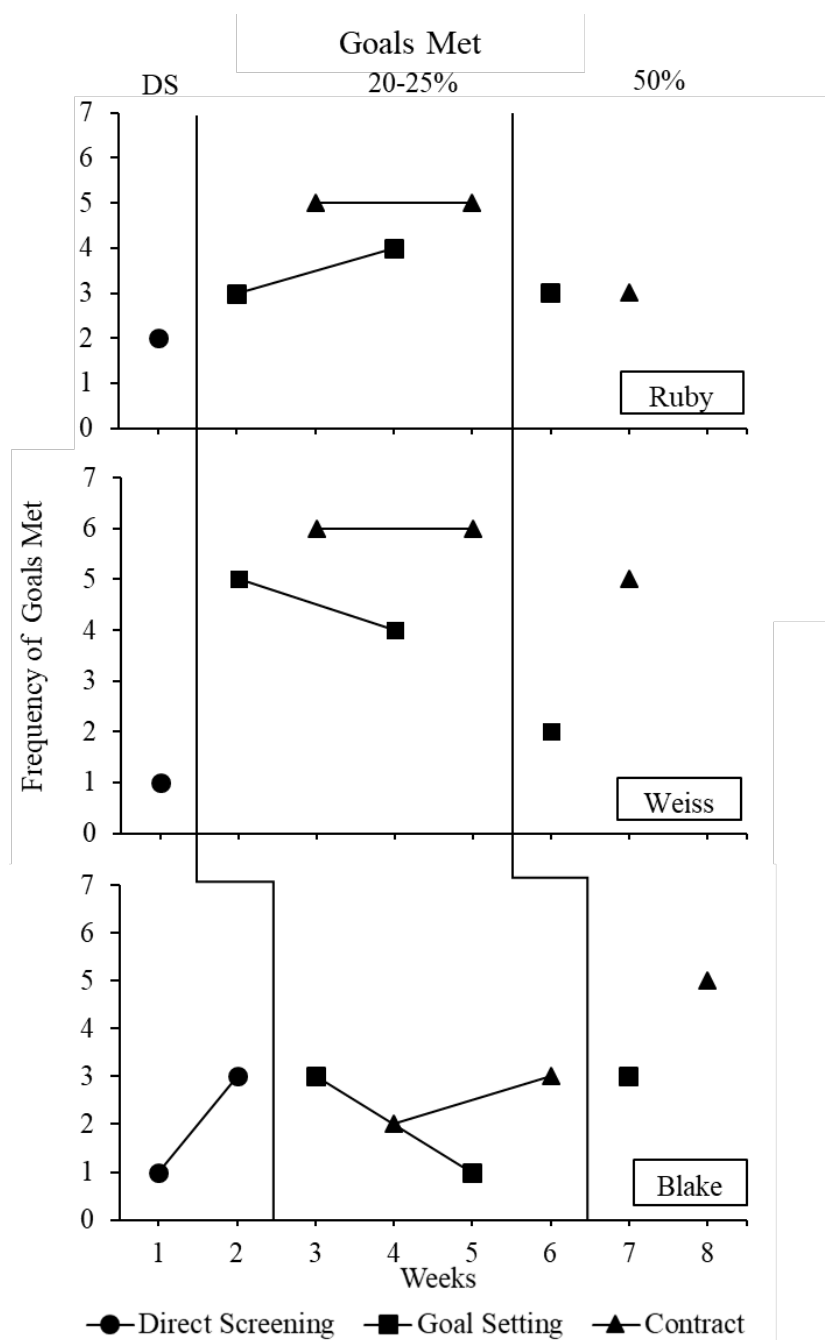


Figure 1. Depicts Goals Met per week for Ruby, Weiss, and Blake across direct screening, contingency contract, and goal setting plus feedback conditions in both the 20-25% and 50% step goal criteria phases.

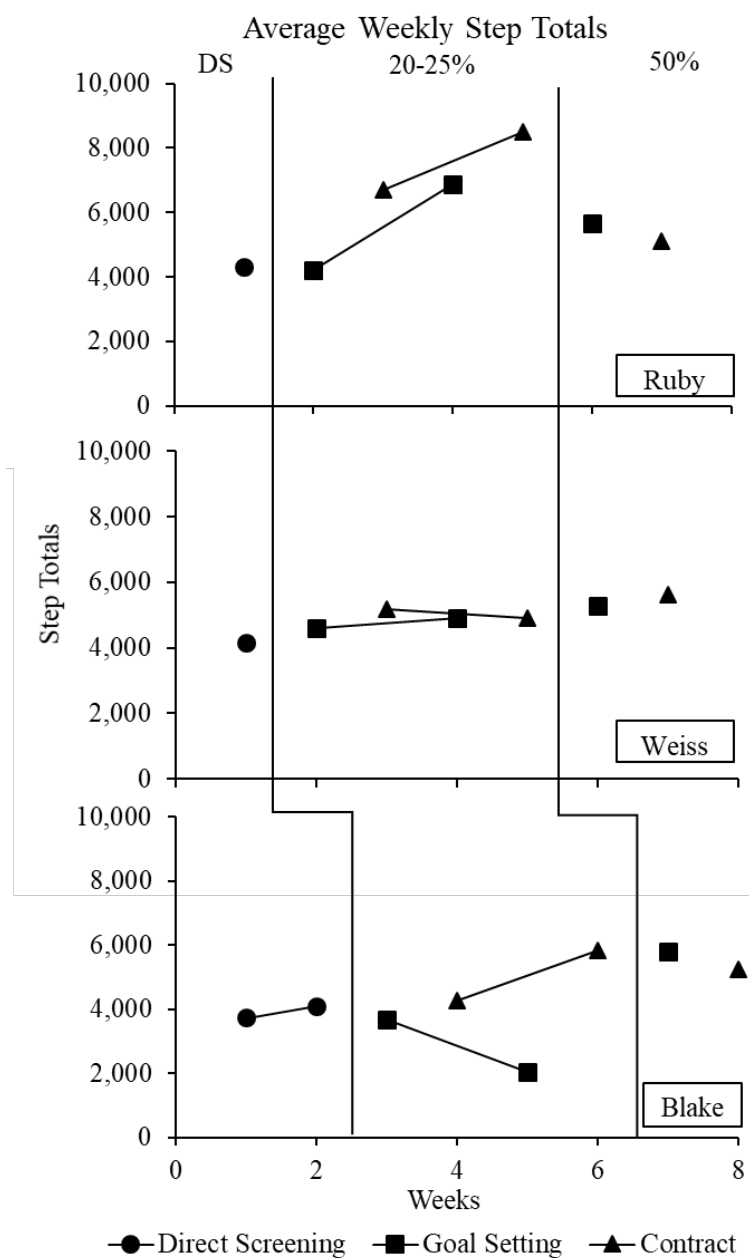


Figure 2. Depicts Average Step Totals per week for Ruby, Weiss, and Blake across direct screening, contingency contract, and goal setting plus feedback conditions in both the 20-25% and 50% step goal criteria phases.

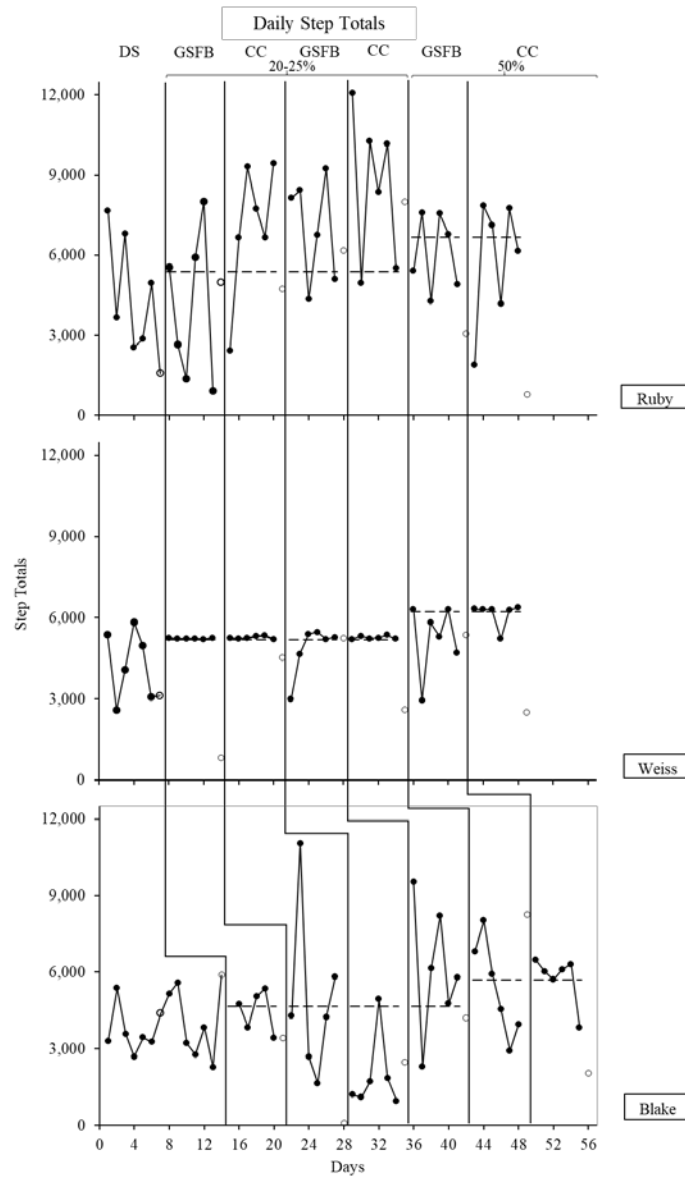


Figure 3. Depicts Daily Step Totals per week for Ruby, Weiss, and Blake across direct screening, contingency contract, and goal setting plus feedback conditions in both the 20-25% and 50% step goal criteria phases. Open circles represent step totals on check-in days when no contingency was in place. Dashed horizontal lines depict the negotiated goals set across phases.

Kara

For Kara the frequency of goals met per week (top panel of Figure 4) was greater in the contract condition (five goals met during both Weeks 2 and 4) compared to goal setting and feedback (four and two goals met during both Weeks 3 and 5 respectively) during the 20-25% goal criteria phases. During the increased 50% goal criteria phases, the frequency of goals met per week decreased across conditions relative to the 20-25% goal criteria phases, however more goals were met per week in the contract condition (four goals met in Week 6) compared to goal setting and feedback (two goals met in Week 7). Kara's average step totals depicted in the top panel of Figure 5 were greater in the contract condition ($M = 7,051$ in Week 2; $M = 5,689$ in Week 4; $M = 6,537$ in Week 6) compared to both baseline ($M = 4,699$) and goal setting plus feedback ($M = 4,463$ in Week 3; $M = 4,127$ in Week 5; $M = 5,330$ in Week 7) across both goal criteria phases. Differences in daily step totals depicted in the top panel of Figure 6 were negligible across all conditions including baseline and goal criteria phases. Daily step totals were observed to be variable across all conditions and goal criteria phases.

Diana

For Diana, the frequency of goals met per week (bottom panel of Figure 4) was greater in the contract condition (six goals met in Week 3 and Week 5) when compared to goal setting and feedback (five goals met in Week 4 and Week 6) during the 20-25% goal criteria phases. During the increased 50% goal criteria phase, the number of step goals met per week decreased across conditions relative to the 20-25% goal criteria phase,

however the number of goals met in the contract condition (five goals met in Week 7) was greater than the number of goals met in the goal setting condition (four goals met in Week 8). For Diana, average step totals depicted in the bottom panel of Figure 5 were greater in the contract condition ($M = 6,871$ in Week 3; $M = 6,988$ in Week 5; $M = 6,908$ in Week 7) when compared to both baseline ($M = 5,448$; $M = 4,886$) and goal setting plus feedback ($M = 6,260$ in Week 4; $M = 6,050$ in Week 6; $M = 6,557$ in Week 8) conditions across both goal criteria phases. Although average step totals observed were greater in contract conditions, minor differences were observed when compared to goal setting and feedback conditions across all goal criteria phases and were deemed negligible. Overall, both experimental conditions had higher average step totals when compared to baseline. For Diana, variability was observed in baseline. Differences in daily step totals depicted in the bottom panel of Figure 6 were negligible across all experimental conditions and goal criteria phases. When compared to baseline, minor variability was observed for daily step totals across all experimental conditions and goal criteria phases. Data were found to be more stable and consistently near the upper limits of baseline performance during experimental conditions.

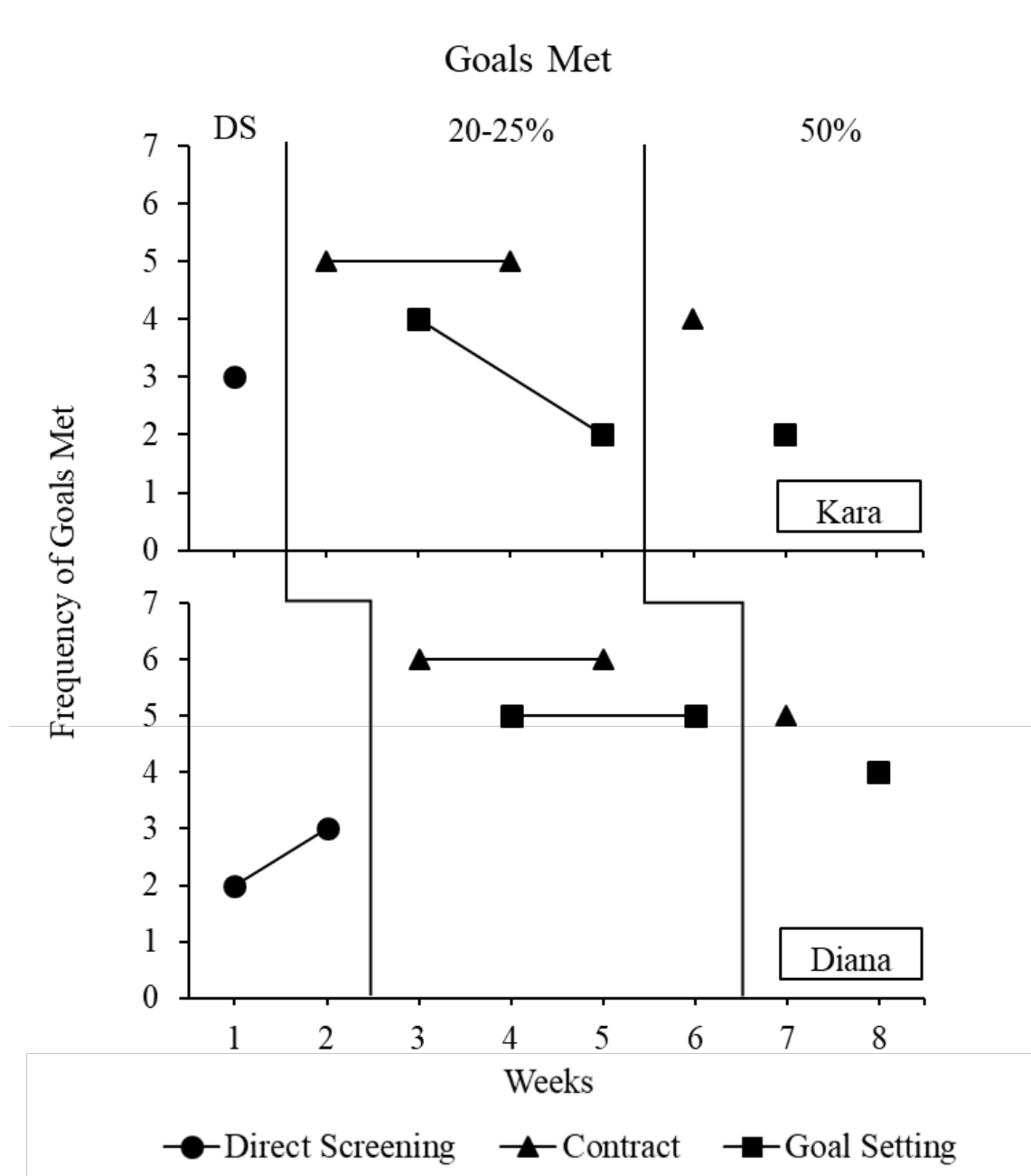


Figure 4. Depicts Goals Met per week for participants Kara and Diana across direct screening, contingency contract, and goal setting plus feedback conditions in both the 20-25% and 50% step goal criteria phases.

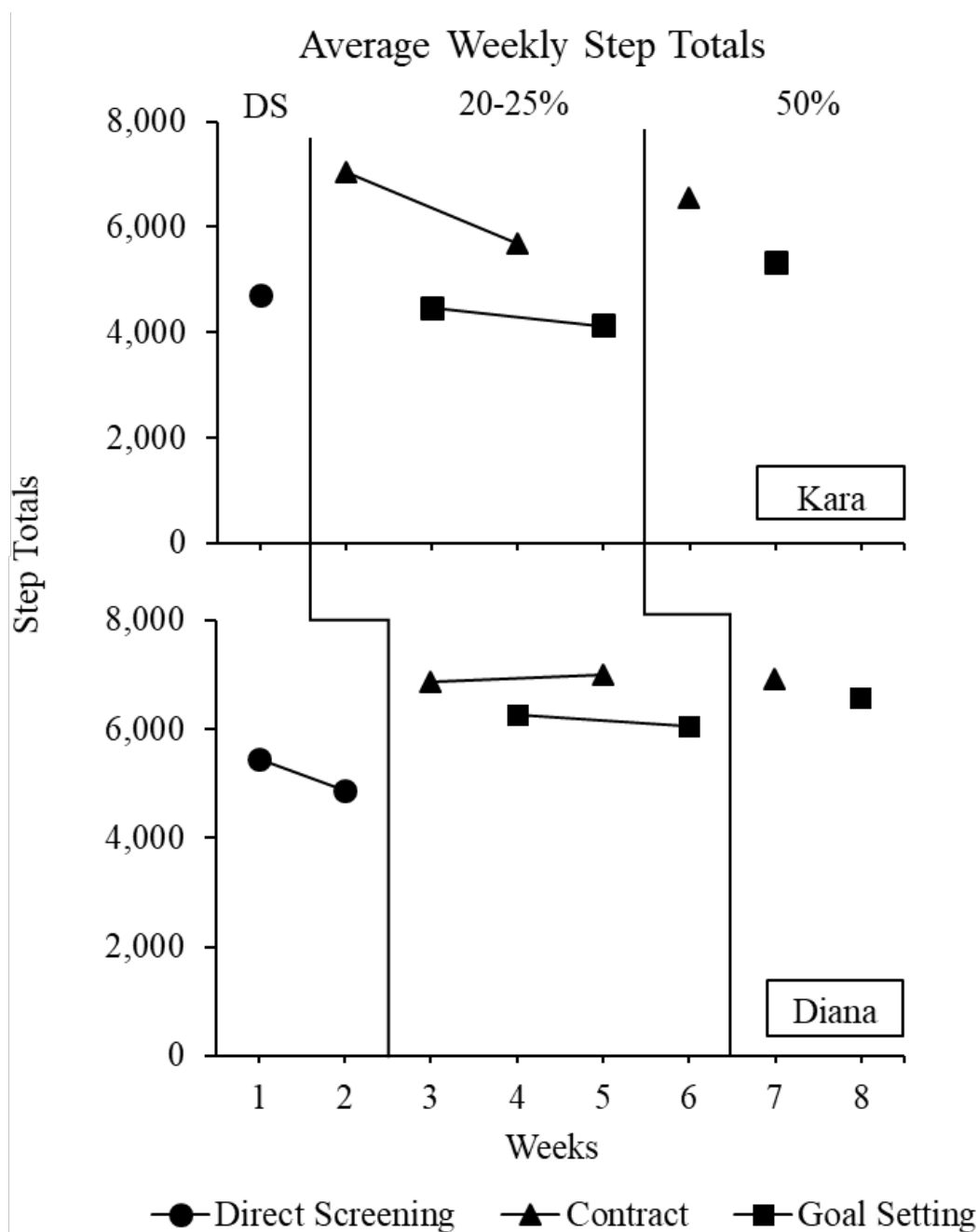


Figure 5. Depicts Average Step Totals per week for participants Kara and Diana across direct screening, contingency contract, and goal setting plus feedback conditions in both the 20-25% and 50% step goal criteria phases.

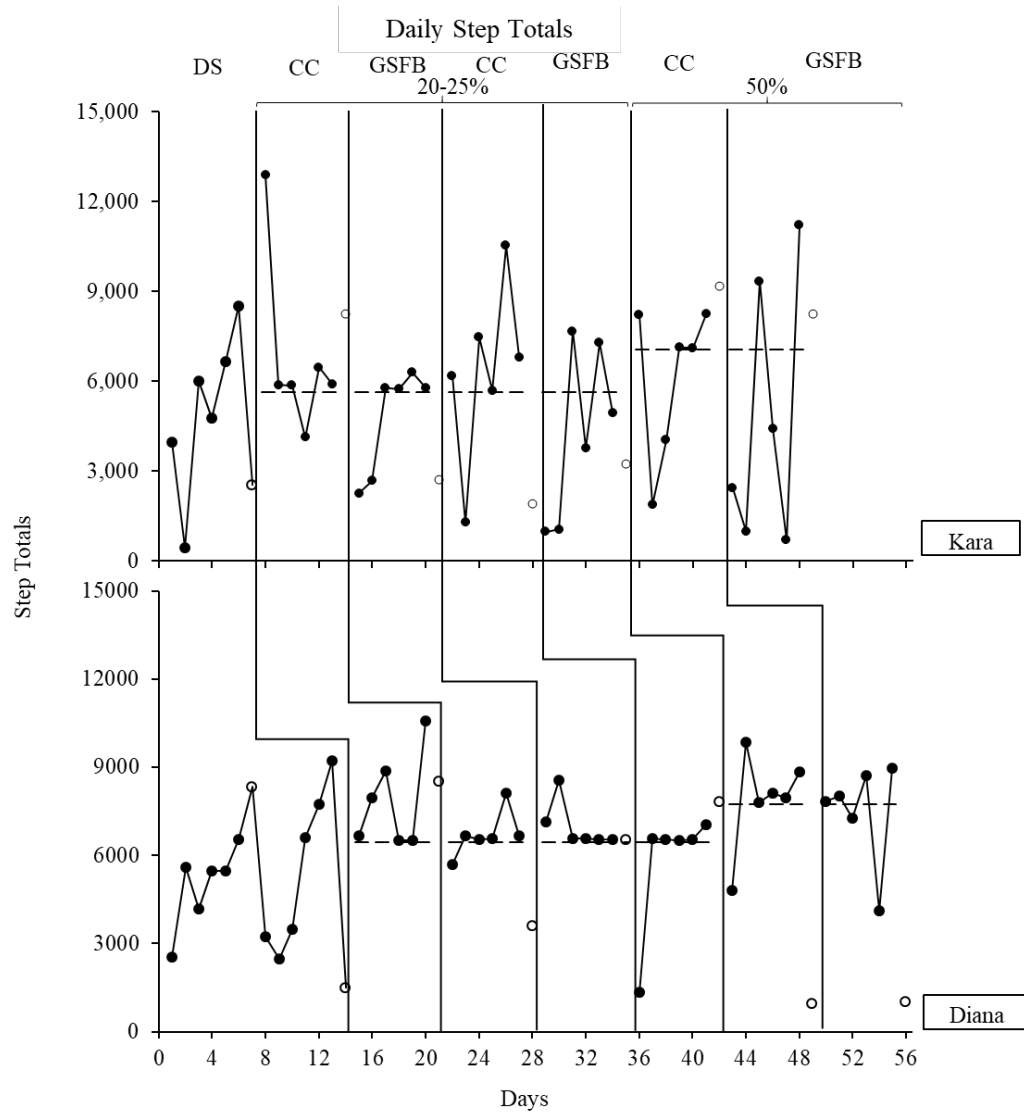


Figure 6. Daily Step Totals per week for participants Kara and Diana across direct screening, contingency contract, and goal setting plus feedback conditions in both the 20-25% and 50% step goal criteria phases. Open circles represent step totals on check-in days when no contingency was in place. Dashed horizontal lines depict the negotiated goals set across phases.

Chapter 4

DISCUSSION

The present study sought to compare the effectiveness of goal setting plus feedback and negative reinforcement contingency contracts for increasing the physical activity of adults. Patel et al. (2016) found that “loss” incentives were more effective in increasing physical activity; however, the authors did not specify the incentives in a contract. Using similar contingencies to Patel et al., the results of Experiment 1 indicated that participants met their daily step goals more often and had higher average daily step counts during the contract condition. Specifically, of the five participants, all five met more goals in the contract condition during the 20-25% goal criteria phase, while all but one participant (Ruby) met more goals in the contract condition during the 50% goal criteria phase. In addition, all five participants had higher average step totals in the contract condition during the 20-25% goal criteria phase, and three of the five participants had higher average step totals in the contract condition than in the goal setting plus feedback condition during the 50% goal criteria phase.

Overall, when comparing both the frequency of goals met per week and average step totals reached to those in direct screening, three of the five participants (Ruby, Weiss, and Diana) consistently surpassed their baseline performance regardless of the condition. These findings suggest that goal setting plus feedback may be sufficient for some individuals who wish to increase their physical activity. However, individuals

might need adjunct interventions, such as a negative reinforcement contracts, to achieve further goal increases. Performance also decreased uniformly when increasing goal criteria from 20-25% to 50%; thus, it remains unclear if the same treatment effects would be observed if participants were exposed to a higher criterion level immediately following direct screening. Finally, the unmasked baseline condition from Experiment 1 calls to question whether the feedback provided from the Fitbit® led to behavior change. That is, it remains unclear if there would be a change in performance across masked and unmasked screening conditions. Thus, the experimenter conducted a second experiment in which the Fitbit® was initially masked during direct screening.

Chapter 5

EXPERIMENT 2

Experiment 2 Procedure

Procedures in Experiment 2 were the same as those in Experiment 1 with the following exceptions. First, direct screening was two weeks in duration, with participants using a masked Fitbit® for the first week of direct screening (i.e., the screen was covered and deactivated), and an unmasked Fitbit® (i.e., the cover was removed and screen fully activated) for the second week. Second, once participants completed direct screening, the experimenter and the participant negotiated the daily step total goals to a minimum of 50% or more than the average step total achieved during direct screening. Finally, the experimenter held this step total constant across all goal setting and contract conditions.

Chapter 6

RESULTS

Two participants, Zatana and Barda, completed Experiment 2. Figure 7 depicts the number of goals met per week for both participants across masked direct screening, unmasked direct screening, goal setting plus feedback, and contingency contract conditions. Average step counts and daily step totals for both participants are depicted across experimental conditions in Figures 8 and 9, respectively.

Zatana

For Zatana, the frequency of goals met per week (top panel of Figure 7) was greater in the contract condition (four and five goals met in Week 4 and 6 respectively) compared to goal setting and feedback (four and one goal met in Week 3 and 5 respectively) during the 50% goal criteria phases. Average step totals depicted in the top panel of Figure 8 were greater in the contract conditions ($M = 6,429$ in Week 4; $M = 5,689$ in Week 6) when compared to both baseline ($M = 4,723$ in Masked Screening; $M = 4,546$ in Unmasked Screening), and goal setting plus feedback ($M = 5,715$ in Week 3; $M = 4,484$ in Week 5) conditions across 50% goal criteria phases. Differences in average step total performance between masked ($M = 4,723$) and unmasked direct screening ($M = 4,546$) baseline conditions were negligible. For Zatana, minor increases in daily step totals depicted in the top panel of Figure 9 were observed in experimental conditions

when compared to baseline. However, differences in daily step totals were negligible across all conditions including. Variability was observed in daily step totals across all conditions.

Barda

For Barda the frequency of goals met per week (bottom panel of Figure 7) was greater in the contract conditions (three and two goals met in Week 6 and 8 respectively) compared to goal setting and feedback (two and zero goals met in Week 5 and 7 respectively) during the 50% goal criteria phases. When compared to baseline ($M = 4,758$ and $3,495$ in Masked Screening; $M = 4,036$ and $M = 4448$ in Unmasked screening), average step totals depicted in the bottom panel of Figure 8 were greater across both contract ($M = 6,592$ in Week 6; $M = 4,262$ in Week 8) and goal setting plus feedback conditions ($M = 6,288$ in Week 5; $M = 4,884$ in Week 7). However, differences between contract ($M = 6,592$ in Week 6; $M = 4,262$ in Week 8) and goal setting plus feedback conditions ($M = 6,288$ in Week 5; $M = 4,884$ in Week 7) were negligible. Differences in average step totals between masked ($M = 4,758$; $M = 3,495$) and unmasked direct screening ($M = 4,036$; $M = 4448$) baseline conditions were negligible. When compared to baseline, minor increases in daily step totals are depicted in the bottom panel of Figure 9 during the first contract (Week 6) and goal setting plus feedback conditions (Week 5) however a decrease in daily step totals was observed in subsequent contract (Week 8) and goal setting plus feedback (Week 7) conditions. When comparing contract and goal

setting plus feedback conditions, differences in daily step totals were negligible across conditions. Variability in daily step totals was also observed across all conditions.

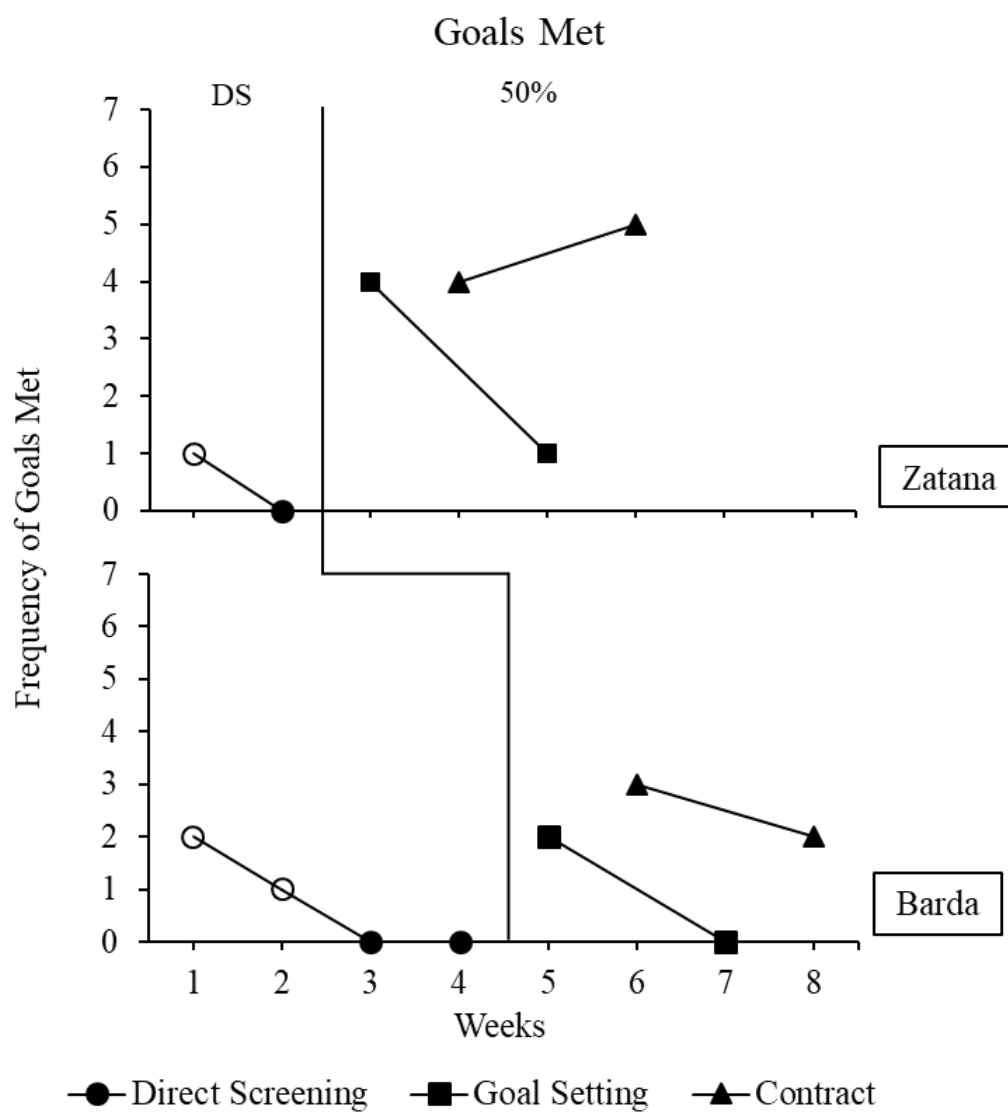


Figure 7. Depicts Goals Met per week for participants Zatana and Barda across direct screening, contingency contract, and goal setting plus feedback conditions in the 50% step goal criteria phases.

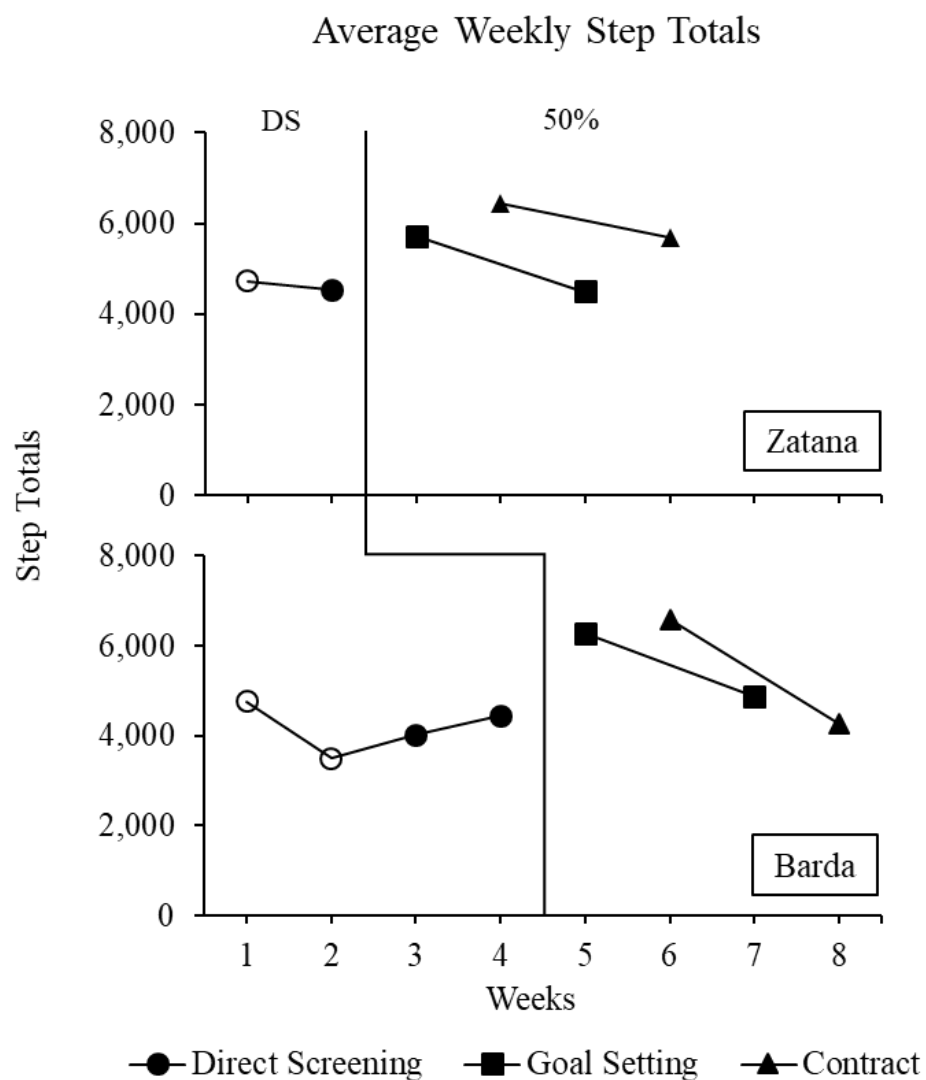


Figure 8. Depicts Average Step Totals per week for participants Zatana and Barda across direct screening, contingency contract, and goal setting plus feedback conditions in the 50% step goal criteria phases.

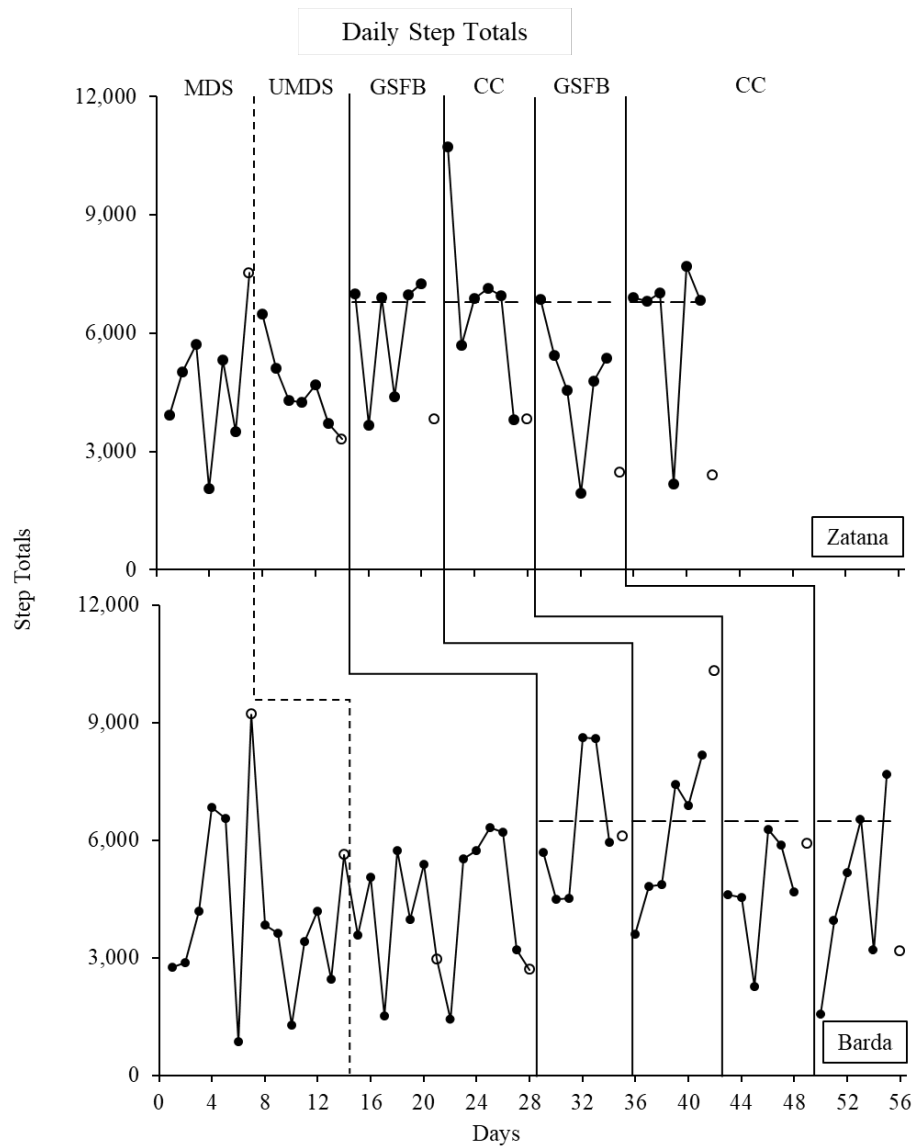


Figure 9. Daily Step Totals per week for participants Zatana and Barda across masked direct screening, unmasked direct screening, contingency contract, and goal setting plus feedback conditions in both the 50% step goal criteria phase. Open circles represent step totals on check-in days when no contingency was in place. Dashed horizontal lines depict the negotiated goals set across phases.

Chapter 7

DISCUSSION

In Experiment 2, two participants began the study without initially receiving feedback (i.e., step totals) from devices during screening. Participants in Experiment 2 were also exposed to only the increased criteria of a minimum of 50% following direct screening. The results of Experiment 2 indicated that step total differences between the masked and unmasked direct screening conditions were negligible. That is, there were no observed differences between not receiving step total feedback and receiving step total feedback from the Fitbit®. The results also indicated that both participants met more goals per week during the contract condition. In addition, both participants had greater average step totals in both goal setting plus feedback and contract conditions when compared to baseline. However, mixed results were found in that only Zatana had higher average step totals in the contract condition during the 50% goal criteria phase when compared to goal setting plus feedback conditions. For Barda, when comparing goal setting plus feedback and contract conditions, differences in average step totals were negligible. Additionally, differences were also negligible for both participants' daily step total performance when comparing goal setting plus feedback and contract conditions. However, both experimental conditions were successful in increasing daily step totals to a minor degree from baseline.

Across both Experiments, four of the seven participants consistently surpassed their performance during direct screening regardless of condition when comparing both the frequency of goals met per week and average step totals reached. In Experiment 2, differences in performance were negligible when comparing masked and unmasked direct screening conditions, suggesting that wearing a tracker alone may not be enough to increase physical activity without a set goal in place. Another potential implication is that it may not be necessary to mask the Fitbit® for screening purposes during research. Although weight was tracked and monitored throughout the course of the study, our findings were similar to those reported from Normand (2008). That is, changes in weight were negligible and therefore not reported. Overall, results indicated that participants met their daily step goals more often and on average had higher daily step counts during the contract condition compared with the goal setting and feedback condition.

Social validity data were also collected via a questionnaire on the final meeting day of the final condition. These data were collected to evaluate whether participants would use contracts for themselves, if they would recommend the use of contracts to others, and whether or not they found the use of contracts helpful after exposure. Results from the social validity questionnaire indicated that of the seven participants, six reported finding contracts to be useful and that they would use contracts for themselves in the future to increase physical activity. Participants also reported the contracts “made me remember something was on the line for not meeting my goals” (Weiss), or “made me accountable for not meeting goals” (Ruby) on the survey. Blake from Experiment 1 also

reported that using the contract to move up in goals “helped make the goals seem attainable”. In addition, all seven participants reported that they would suggest the use of contracts to others looking to increase their physical activity.

Four of seven participants reported that they had no suggestions to improve upon the contract condition. However, one participant (Zatana) from Experiment 2 reported that the daily feedback from the Fitbit® tracker alone was not very helpful. Zatana also reported that she may have performed better if she also had access to the Fitbit® phone application, because she could get goal notifications on her phone, rather than determining if she had met her goal through step totals on the Fitbit® screen alone or waiting until the meeting days.

Participants also provided suggestions for the reinforcement contingency. Ruby from Experiment 1 mentioned that she would have been more inclined to further improve her performance during the 50% goal criteria phase if there was “more money to be earned for increasing goals” and suggested scaling the money earned along with the increase in difficulty. Similarly, Barda in Experiment 2 reported that the potential money earned in the contract condition (i.e., \$21) was “not enough to motivate me much more than the other condition with just the goal”, and had the amount been greater, she would have “worked harder to walk more for the last two weeks”. Barda also suggested, “paying participants around \$50 and losing about \$6 for missed goals instead”, with the accompanying rationale that, “each missed goal would basically be the value of a meal,

so it would be worth it”. Lastly, Barda suggested the having participants “deposit their own money” as she “would have probably done more walking to get it back”.

Limitations

Several limitations should be noted across both experiments and from the feedback gathered from participants. First, feedback was provided in several ways, including daily feedback from the Fitbit® (i.e., lights, step totals) and weekly performance feedback (i.e., Fitbit® website, weekly step totals, graphic feedback). The experimenter aimed to maintain as much control over the Fitbit® application and website as possible to avoid the participants’ ability to manipulate the device settings; thus, access to the mobile application and website was restricted to participants. However, participants reported that additional feedback received across conditions might have further increased their performance. If participants had access to the mobile application, it would have been possible to remotely sync the Fitbit Zip™ as no other device would be needed to do so. This modification to the procedure could have technically allowed investigators to implement the suggestions by participants to improve feedback given. This would have also provided participants a more naturalistic use of the Fitbit® devices. Additionally, as investigators became more familiar with Fitbit® related materials, it was found that any changes made could have been checked at the weekly meetings and changing the settings back would re-calculate the step totals using the correct information without losing data.

Another limitation was the magnitude of monetary reinforcement available across studies. In Experiment 1, participants had to increase their negotiated step goal from 20-25% above the average in direct screening to a minimum of 50% in later goal phases. However, the amount of monetary reinforcement (i.e., \$21) did not increase when the goal increased. Decreases in performance in both goals met and average step totals were observed across participants when increasing their step goals. Performance was also observed to decrease over time across both experimental conditions in Experiment 2, despite participants not having been exposed to a previous step goal. When completing the social validity questionnaire, some participants reported that reinforcement did not appear to be adequate for the response effort increase in Experiment 1 and not adequate for the amount of effort required for one participant in Experiment 2. Thus, despite most participants performing better in the contract condition than the goal setting plus feedback condition during the 50% goal criteria phases, it is possible that if reinforcement was scaled to reflect the increased response effort, further increases might have been observed. The suggestion of increasing payment to about \$50 would be similar the amount used by Donlin-Washington et al. (2016) to increase the step totals of college participants. Another potential limitation was that rather than providing funds for participants, the contract procedure would have been more powerful if participants had to deposit their own money. Previous research utilizing negative reinforcement contracts to increase physical activity have had participants deposit either personal belongings (Wysocki et al., 1979) or money (Donlin-Washington et al., 2016) and in each respective

study were found to be successful in increasing physical activity. Thus, it is possible that participants across both experiments could have potentially further improved their performance if their own money was used to motivate them.

Finally, the duration of time participants spent in direct screening could be considered a limitation of the current study. Participants in Experiment 1 were in the direct screening phase for only 1-2 weeks in direct screening compared with 2-4 weeks of direct screening for participants in Experiment 2. Although similar to the amount of time participants spent in baseline in the Donlin-Washington et al., (2016) study. It is possible that participants in both experiments had some initial reactivity to wearing the Fitbit® and may not have been exposed to the device for enough time to capture a more naturalistic baseline level for step totals. Alternatively, the duration in contract conditions in the current study one week, whereas in the Donlin-Washington et al. (2016) study, participants were observed in the treatment condition for at least three weeks with adult participants. It is possible that further increases could have been observed had the treatment conditions been run out for an additional two or more weeks.

Future Directions

Taken together, the findings from both experiments suggest that goal setting plus feedback might be sufficient for some individuals who wish to increase their physical activity. However, as previously mentioned, individuals might need adjunct interventions, such as a negative reinforcement contracts, to achieve further goal

increases. Researchers should consider the following recommendations when investigating similar procedures in the future.

First, researchers might consider manipulating the magnitude of reinforcement when utilizing negative reinforcement contracts with monetary rewards, such as scaling the reinforcement to better match the response effort required when increasing goal criteria. Second, researchers might also consider the use of deposit contracts with funds provided by participants, rather than funds supplied by the experimenter. However, both the potential funds earned and amount lost for not meeting goals need to be sufficient to help motivate individuals to meet goals. This individualized amount might be informed via participant interviews prior to the start of experimental conditions. Deposit contracts might also be compared with experimenter-funded contracts (similar to a bonus from meeting employer physical activity criteria). Third, researchers might consider replicating the procedures used in the current study while also providing access to the mobile application and including daily feedback with the most up-to-date information on the remaining amount of the monetary reward. Finally, researchers might limit reactivity to the device and capture a more accurate baseline level of performance by increasing participants' time in direct screening and or utilize treatment conditions that last more than one week.

APPENDIX A

Recruitment Flyer

Hey there Hornets! Interested in
getting fit...with science?

Want a chance to earn a few bucks
just walking around?

Want a chance to rock a
Fitbit® while you do?

Then look no further!

Graduate students at the psychology department are looking for participants for a physical activity study! If you are interested in taking part in the study, please send an email to: davidhernandez@csus.edu to set up a meeting for additional information! Hurry as spaces for participation are limited!

If Interested, please type "Fitbit Study" in the subject line when trying to contact the Primary Investigator. Thank you!

APPENDIX B

Physical Activity Stages of Change Questionnaire

For each of the following questions, please circle Yes or No. Please be sure to read the questions carefully.

Physical activity or exercise includes activities such as walking briskly, jogging, bicycling, swimming, or any other activity in which the exertion is at least as intense as these activities.

- | | | |
|--|----|-----|
| 1) I am currently physically active. | NO | YES |
| 2) I intend to become more physically active in the next 6 months. | NO | YES |

For activity to be regular, it must add up to a total of 30 minutes or more per day and be done at least 5 days per week. For example, you could take one 30-minute walk or take three 10-minute walks for a daily total of 30 minutes.

- | | | |
|---|----|-----|
| 3) I currently engage in regular physical activity. | NO | YES |
| 4) I have been regularly physically active for the past 6 months. | NO | YES |

Adapted from Marcus, Rossi et al., (1992)

Please circle Yes or No to the following question.

- | | | |
|--|----|-----|
| 5) Have you ever owned or currently own a Fitbit®? | NO | YES |
|--|----|-----|

PP#_____

_____/_____

APPENDIX C

Goal Setting and Feedback

I, _____, agree to wear the Fitbit® every day and reach at least _____ steps daily, every day for the week beginning, _____, and ending _____.

I also agree to come back on _____ for the weekly meeting to get my \$5 gift card from David, and to have him take weight and step total data from the Fitbit®.

APPENDIX D

Negative Reinforcement Contingency Contract

I, _____, agree to wear the Fitbit® every day and reach at least _____ steps daily, every day for a week beginning, _____ and ending _____.

At beginning date _____, I will start with a \$21 gift card that will be given during the next meeting. David will remove \$3 from that gift card for every day that I do not reach my daily step total goal.

I also agree to come back on _____ for the weekly meeting to get my gift card from David, and to have him take weight data and step totals from the Fitbit®.

Signature: _____

Participant

Date: _____

Signature: _____

David - Primary Investigator

Date: _____

APPENDIX E

Social Validity Questionnaire

Please circle one option for all items below

1. After having experienced the contract, would you use one yourself to motivate you in the future? (please circle one)

YES **NO**

a. And why?

2. Would you recommend the use of a contract to someone else? (please circle one)

YES **NO**

a. And why?

3. Did you find the use of a contract helpful in motivating you increase your step totals?

4. What feedback do you have for the contract that was used, if any?

P#_____

APPENDIX F

Data Sheet

Participant #: _____

Date: _____

Step total goal for the week: _____ steps daily

Step total data:

Condition: _____

• _____ (A / D)

• _____ (A / D)

• _____ (A / D)

• _____ (A / D)

• _____ (A / D)

• _____ (A / D)

• _____ (A / D)

• Weight: _____

IOA: _____ (agreements) / _____ (agreements + disagreements) = _____

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