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BRIEF PRACTICE

Using a Lottery to Promote Physical Activity by Young Adults with Developmental Disabilities

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Abstract

Exercise benefits adults with developmental disabilities. A prior study demonstrated that a treatment package comprising goal setting and fixed-ratio 1 reinforcement for goal attainment substantially increased walking. However, continuous reinforcement delivery may be untenable due to cost and time. In an effort to develop a more practical package intervention, we evaluated a procedure that involved setting goals for steps taken each 6-h school day and a lottery system for awarding prizes for goal completion. Three of the four participants took substantially more steps when the intervention was in effect, and all of them rated it as highly acceptable.

Keywords Accelerometers · Developmental disabilities · Exercise · Goal setting · Lottery · Reinforcement

Physical exercise contributes to the physical and psychological well-being of people (Johnson, 2009), but many adults are inactive (Centers for Disease Control, 2003), a problem that is especially common among adults with developmental disabilities (DD; Bodde & Seo, 2009). Integrating opportunities to engage in physical activity within daily activities, such as walking during downtime or using stairs rather than elevators, is a recommended strategy for increasing physical activity and may be especially beneficial for adults with DD (Bodde & Seo, 2009). La Londe, MacNeill, Eversole, Ragotzy, & Poling (2014) used goal setting and reinforcement to foster walking by young adults with DD during downtime at their educational program. Each of the five participants walked substantially more when the intervention was in effect and regularly took 10,000 steps during the school day in this condition but not in the baseline condition. Reinforcers in this study were participant-selected prizes made available each time a daily step goal was met. A similar strategy was used by Kurti & Dallery (2013), who provided monetary compensation to adults without DD every third consecutive day they met their step goals.

Cost and staff effort are two major considerations in evaluating interventions for increasing exercise in school settings. Changing the procedures used by La Londe et al. (2014); Kurti & Dallery (2013) to incorporate intermittent reinforcement, as arranged in the drawings characteristic of lotteries (Wine, Edgerton, Inzana, & Newcomb, 2017), may reduce cost and effort and thereby increase the range of situations in which they could be used to increase exercise. Prior studies with college students demonstrated that such reinforcement arrangements were effective in increasing college students' walking (Donlin Washington, Banna, & Gibson, 2014) and participation in aerobic classes (Epstein, Wing, Thompson, & Griffin, 1980). Given the potential practical value of using a lottery system to arrange reinforcers, we examined the use of one as part of a treatment package intended to increase the number of steps taken each day by young adults with DD.

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Method

Participants and Setting

A recruitment presentation was given to a 12-student classroom in a Midwestern postsecondary educational program. The program provided transition services for young adults

with DD from 18 through 26 years of age. The students attended the program from 7:30 a.m. to 2:00 p.m. on weekdays. Program activities included classroom instruction, vocational training, and community outings intended to foster adult living, community participation, and job-readiness skills. There were opportunities for students to walk around school property during free-time periods (e.g., during scheduled breaks and after early completion of work).

Four participants, herein named Audrey, Beth, Dale, and Ethan, volunteered for the study after recruitment. All participants expressed interest in increasing their physical activity and had no characteristics that prevented them from doing so. The study was approved by school administrators and a university human subjects institutional review board. Informed consent was obtained from all participants who had the wherewithal and legal status to confer it.

Audrey was a 21-year-old Black female student diagnosed with autism spectrum disorder (ASD) who attended the program 5 days a week. Beth was a 23-year-old Black female student diagnosed with cognitive impairment who attended the program 3 days a week. Dale was a 23-year-old White male student diagnosed with cognitive impairment who attended the program 3 days a week. Ethan was a 25-year-old White male student diagnosed ASD who attended the program 4 days a week.

All participants had good verbal skills (e.g., independently initiated conversation, asked and answered questions, and could comprehend rules and numbers).

Materials

Participants were provided with and instructed to wear a Fitbit Zip™ (Fitbit, San Francisco, California) on their belt loop, waist band, or participant-selected pocket during the school day. A silicone clip was used to hold the device in place. The Fitbit Zip™ is a three-axis accelerometer that tracks number of steps (and other metrics not used for this study) and weighs 8 g (dimensions: 0.55 cm × 0.43 cm × 0.15 cm). A researcher or classroom aide reminded the participants at the beginning of the school day to wear the trackers and at the end of the school day to take them off before leaving the program. Each participant's desk had a small cup designated to store the activity tracker when not in use. Data from each participant's Fitbit Zip™ were synchronized via Bluetooth using an Apple iTouch device at the end of the school day. Other project materials were a goal-setting sheet positioned in the upper-right-hand corner of each student's desk, token pieces used for the lottery drawing (duck-shaped wooden pieces with participants' names on them, approximately 7.5 cm × 3.75 cm), and a prize box containing a variety of inexpensive (less than US$5.00 each) items reported by the participants to be highly preferred.

Procedure

The study spanned one school semester (70 school days), but the number of sessions (i.e., days with data collected) varied (from 32 to 65) across participants because of differences in their schedules and absences from school due to illness or other reasons. An A-B-A-B design was used in the study, with A designating the baseline condition and B designating the treatment condition.

Baseline Participants were instructed to wear the Fitbit Zip™ at the beginning of the school day and reminded to remove the device at the end of the school day before going home. No programmed consequences were provided for step count by any member of the research team, teachers, or other school personnel. Data for each participant, in the form of the number of steps recorded by the Fitbit Zip™, were recorded at the end of each day. Goal-setting sheets were left blank on the students' desks.

Intervention Following baseline, a member of the research team met individually with participants to demonstrate how to view their daily steps on the device's screen. The researcher used behavioral skills training (Reid & Parsons, 1995) to ensure that participants could access their step counts. All participants were able to do so independently within one session. Next, the researcher informed each student that he or she would receive a goal written on the goal sheet on his or her desk every morning, and that if the number on the goal sheet matched or was exceeded by the number on the device at the end of the day, then the student would receive a token and participate in that day's prize drawing. The goal sheet contained five rows, one for each weekday, and three columns: goal, daily steps, and goal attained (yes or no). For students who were not scheduled to attend the program all 5 weekdays, dashes were used to indicate days when students were not at school.

The first goal for all participants was set at 10% above the mean number of steps per day during baseline. Goals were increased by 10% after two consecutive sessions of meeting the goal; however, the highest goal set for each participant was limited to a value that school staff and members of the research team believed could be regularly attained without disruption of regular school activities, excessive fatigue, or participant distress. This goal-setting procedure was based on the one previously and successfully used by La Londe et al. (2014).

For each participant, at the end of each day, a researcher recorded the number of steps taken in the daily steps column on the goal-setting sheet next to the goal, asked the student whether that day's goal was met, and recorded whether it was. Participants always correctly indicated whether or not their goals were met. If a participant met the goal for a day, that

participant was given a token that had his or her name written on it and placed the token in the opaque jar used for the prize draw. After all the eligible participants placed their tokens in the jar, a researcher randomly selected one token and read the name on it to announce the winner for that day. The winner was then immediately allowed to choose a prize from the prize box. Prize draws were held during the last 15 min of the school day, and only one drawing took place per day. All students were exposed to the lottery condition simultaneously, with the exception of Dale, who started a week later than the others.

Treatment Integrity

Treatment integrity data were collected at the end of 17% of the total sessions, selected at random. One member implemented the lottery intervention while the other recorded whether or not each step of the procedure (recording step count, providing no programmed consequence in baseline, providing a token to each participant who met that day's goal, drawing a token from the container, naming the winner, allowing the winner to choose a prize from the prize box, and updating participant goal sheets for the next day) was followed correctly. Daily treatment integrity averaged 98.2%, with a range across sessions of 80% to 100%.

Social Validity Questionnaire

Participants were given a six-item written questionnaire at the conclusion of the study to complete independently. The first two items asked whether the participant liked wearing the Fitbit™ and whether or not he or she would choose to participate in the walking program during the next school year. All participants answered "yes" to both questions. The remaining four items asked participants to respond to statements about the intervention using a 5-point ordinal scale, with 1 indicating *strongly disagree* and 5 indicating *strongly agree*. These statements were as follows: (a) "I was happy with this project," (b) "I liked having my step counts recorded by the researcher," (c) "I liked the lottery system because I got a chance to win a prize when I met my goal," and (d) "This project helped me increase my physical activity." The average acceptability rating was 4.8, with a range across statements of 4.3 to 5.0.

Results and Discussion

A previous study that applied goal setting and reinforcement procedures similar to those of the present study in a comparable setting demonstrated substantial treatment effects in each of five participants (La Londe et al., 2014). Prizes were awarded under a fixed-ratio 1 schedule in that study; every time a daily goal was met, a prize was awarded. In contrast, prizes were awarded under a lottery system in the present study. As shown in Fig. 1, three of our four participants walked more when the intervention was in effect than during the baseline condition. During the initial baseline condition, Audrey, Beth, and Ethan walked an average of 5,862, 6,899, and 7,958 steps per day, respectively. Their respective average daily step counts increased to 8,539, 8,989, and 10,187 during the initial exposure to the intervention. After the intervention, their respective mean daily steps decreased to 6,841, 7,415, and 9,286. In the second intervention phase, all three participants increased physical activity, with mean step counts of 7,421, 8,474, and 10,689 for Audrey, Beth, and Ethan, respectively. Their respective terminal goals were 8,858, 9,181, and 10,137 daily steps. In contrast to the other participants, mean steps taken by Dale decreased from the initial baseline condition (7,020) to the first intervention phase (6,061), rose in the second baseline condition (7,267), and fell in the final intervention condition (7,046). Dale's step goal increased only once.

In contrast to the findings of La Londe et al. (2014), the number of steps taken each day by participants in the present study did not progressively increase across the intervention phase, although as noted daily goals did increase for three participants. Moreover, the increase in mean steps taken from the initial baseline condition to the first treatment condition was substantially smaller for participants in the present study than for participants studied by La Londe et al. (2014). Variability within phases was substantial in both studies and did not differ markedly from the baseline condition to the treatment condition in either study. Irregularly scheduled off-campus activities that required or prevented walking and differences across days in the amount of downtime available for a given participant to walk undoubtedly contributed to variability and were unavoidable.

A number of variables may have contributed to the somewhat dissimilar results obtained by La Londe et al. (2014) and in the present study. Nonetheless, it is likely that the schedule of reinforcement arranged for meeting goals was a contributing factor. In the La Londe et al. (2014) study, a prize was awarded each time a step goal was met. Individual participants in the present study won the lottery and received a prize an average of 9 times (range 4–15). Odds of winning in the draws in which that person participated ranged from 36.4% to 62.5% across students. The open circles in Fig. 1 indicate the winner of each session's lottery. Dale only participated in the lottery on eight occasions and won four times. Dale entered the lottery twice in the first three sessions of intervention but never won. His relatively infrequent contact with the lottery system and the consequences it arranged may have accounted, at least in part, for the absence of a treatment effect in his data. His subsequent decrease in steps could be attributed to extinction. Very rich schedules are necessary to generate desired levels of behavior in some cases, and this may have been the case with Dale. Dale also entered the intervention phase a week after the

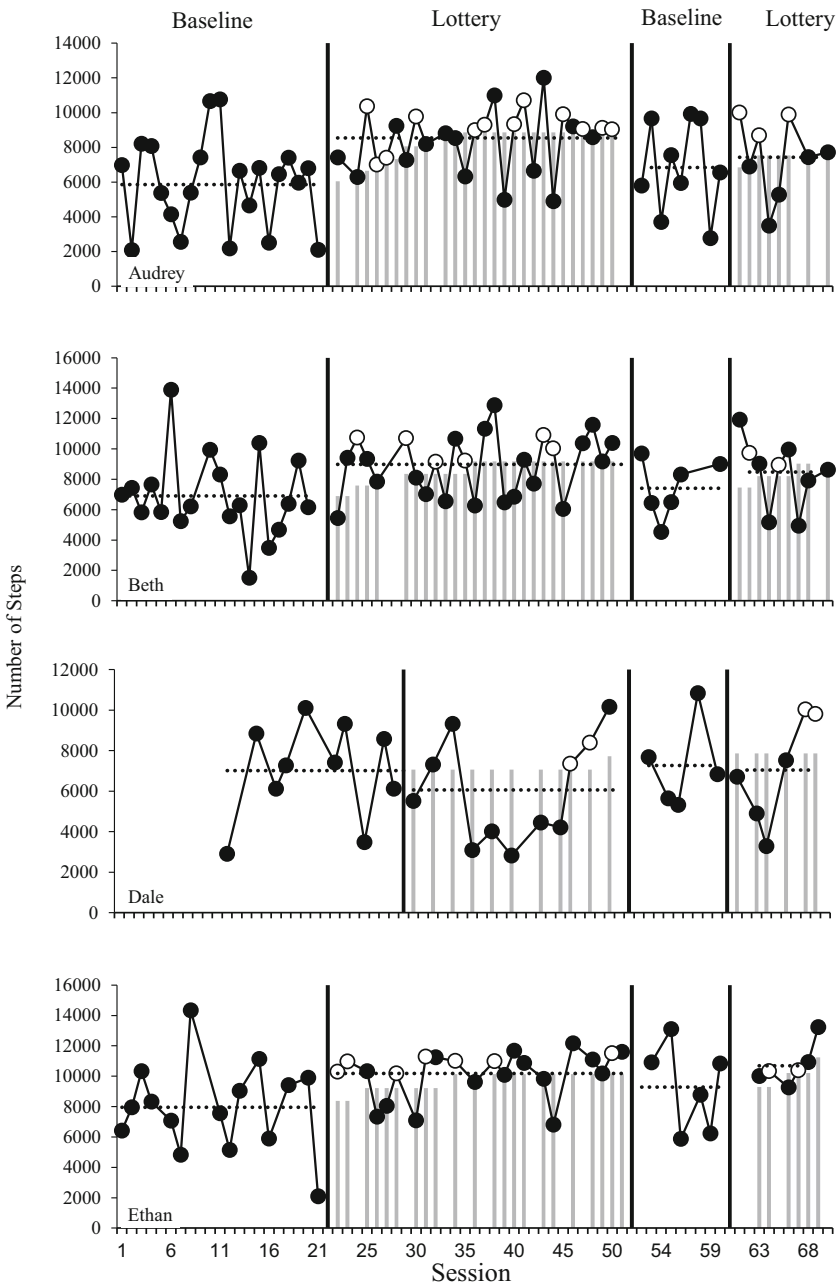

Fig. 1 Steps taken each day by every participant under all conditions. Dashed horizontal lines depict mean daily steps for the indicated condition. Gray bars show daily step goals, and open circles denote lottery winners

other participants, which may have influenced his performance. It should be noted the average odds for participants in the first week and subsequent weeks following Dale's participation remained the same (53.8%).

Walking 10,000 or more steps per day is generally recognized as sufficient exercise to confer health benefits (e.g., Iwane et al., 2000). Only one of our participants attained this level of exercise, but the intervention was operative for only 6 h each day. Had we recorded the steps taken by the participants outside the research setting and added them to the present data, it is probable that three of the four participants would have walked at least 10,000 steps on most of the days that the intervention was in effect.

Overall, the participants were well satisfied with the lottery system for awarding prizes, and it was quick and easy to arrange. Moreover, it was relatively inexpensive because only one prize was awarded each day, and the cost of all prizes was below US$5.00. Nonetheless, comparing the results of the present study to those of La Londe et al. (2014) suggests that a system that arranges consistent and high-probability prizes for goal attainment may be more effective than a lottery system. The intervention used in the present study contained multiple elements (i.e., goal setting, feedback, prizes intended as reinforcers), and further research examining how those elements interact to affect exercising is merited. So, too, is research examining how these elements should be arranged to

maximize benefits for participants without being unacceptable in terms of staff effort or financial cost. Until such work is finished, practitioners are well advised to use the richest schedule of reinforcement they can manage to arrange.

Implications for Practice

- Goal setting and probabilistic reinforcement in the form of a lottery was an effective and efficient procedure for increasing exercise in three out of four young adults with DD.
- Fitbit™ accelerometers allowed easy tracking of physical activity, operationally defined as steps taken during each school day.
- Promoting participants' walking throughout the day via goal setting and reinforcement appears to be a viable strategy for increasing activity in adults with DD.
- Lottery systems may be a feasible intervention in school-based settings if continuous-reinforcement systems are not viable.

Compliance with Ethical Standards

Conflict of Interest Anita Li declares she has no conflict of interest. Hugo Curiel declares he has no conflict of interest. Steven Ragotzy declares he has no conflict of interest. Alan Poling declares he has no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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