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Research Report

A Theory-Based Physical Education Intervention for Adolescents with Visual Impairments

Justin A. Haegele and David L. Porretta

Regular physical activity participation can have a positive impact on overall health. However, school-aged individuals with visual impairments tend to be less physically active than their peers without disabilities (Haegele & Porretta, 2015). Fortunately, preliminary intervention research suggests that physical activity levels of those with visual impairments can be improved (Haegele & Porretta, 2015). For example, Cervantes and Porretta (2013), using a social cognitive theory–based intervention, examined the effect of an after-school physical activity program on adolescents with visual impairments. Their study offered a nine-lesson program to four students at a residential school over a five-week period. Results indicated that leisure-time physical activity levels were enhanced by the intervention (Cervantes & Porretta, 2013).

Social cognitive theory is considered among the most acceptable models for understanding health promotion behavior (Motl, 2007). It is a general theory of human behavior that stipulates that people are active agents in their own lives as they generate thoughts, feelings, and behaviors (Bandura, 2001). The model of causation which is central to social cognitive theory is triadic reciprocal determinism, which suggests that one's behavior, personal factors, and environmental influences influence each other bi-directionally (see Figure 1; Bandura, 2001; Motl, 2007). The reciprocal nature of human functioning in social cognitive theory allows researchers to direct interventions at several interrelated constructs in order to change behaviors. Common constructs exploring influences of physical activity behavior, central to the program implemented by Cervantes and Porretta (2013) and to this study, are self-efficacy, self-regulation, outcome expectancies, and social support.

The need to increase physical activity at an early age has stimulated the development of school-based interventions for all students. Research suggests that school-based interventions can successfully increase physical activity (Kriemler et al., 2011). However, few studies focusing on individuals with visual impairments have been conducted. Thus, the purpose of this study was to determine the effects of a social cognitive theory–based physical education program on the leisure-time physical activity among adolescents with visual impairments. In this study, the successful social cognitive theory–based after-school program utilized by Cervantes and Porretta

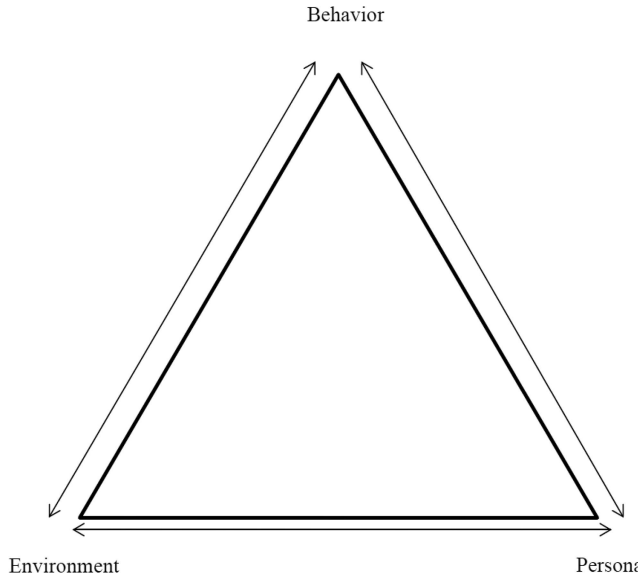

Figure 1. Triadic reciprocal determinism.

(2013) was implemented as a physical education program. Within the framework of social cognitive theory and triadic reciprocal determinism, this study sought to enhance participants' personal factors (self-efficacy, outcome expectancies, and self-regulation) and environmental influences (social support) in order to impact their behavior (that is, physical activity participation).

Methods

Participants

Four participants (two males and two females), aged 15 to 17 years and attending a Midwestern residential school for blind students, were purposively sampled based on: (a) not being enrolled in another physical activity intervention, (b) not being active members of interscholastic sport, (c) having no ambulation-related disabilities, and (d) having the ability to wear Fitbit Zip devices throughout the day. Participants were selected from two physical education classes: first period (participants 3 and 4) and ninth period (participants 1 and 2). Characteristics of the participants are presented in Table 1.

Setting

The intervention was delivered during the physical education class period in either the gymnasium or the health education room. During after-school hours, participants had access to physical activity opportunities that were available to them on a regular daily basis (for example, walking in the neighborhood).

Table 1
Characteristics of the participants.

Participant	Age	Grade	Gender	Mobility device	Residential status
1	17	11	Female	Cane	Part-time day student
2	17	11	Male	Cane	Part-time day student
3	15	9	Male	None	Full-time day student
4	16	11	Female	Cane	Full-time day student

Table 2
Intervention lesson outline and social cognitive theory constructs.

Lesson	Lesson name	Targeted social cognitive theory construct
1.	Completing exercise logs	Self-regulation
2.	Exercise and health	Outcome expectancy values
3.	Goal setting	Self-regulation
4.	Reasons not to exercise	Self-efficacy
5.	Keeping track of your exercise: talking pedometers	Self-regulation
6.	Where to exercise and exercise motivators	Outcome expectancy values
7.	Friends and family can help you exercise	Social support
8.	Exercise intensity	Outcome expectancy values; self-efficacy
9.	Plan to keep going	Self-regulation

Intervention

This study's intervention was modeled after an existing program, entitled "Plan for Exercise, Plan for Health" (Stevens, 2006), and previously implemented by Cervantes and Porretta (2013). The program consisted of nine instructional lessons, and each lesson was infused with one or more social cognitive theory constructs (see Table 2). The school's physical education teacher taught all lessons (both lecture- and activity-based). Participants 1 and 2 received one session per week over nine weeks. Participants 3 and 4 received two sessions per week over five weeks. Lessons were presented over one class period each, and they varied in duration from 18 minutes, 28 seconds (lesson seven), to 32 minutes, 28 seconds (lesson eight). Physical education classes then continued as usual for the remainder of the class period. Each session began with an introduction to the topic to be discussed, followed by an in-class discussion or activity, and concluded with directions to complete homework. Homework assignments focused on applying topics discussed in class outside of school. For example, the homework assignment for lesson five (keeping track of your exercise: talking pedometers) asked students to wear a talking pedometer throughout the week and record what exercises they did, the number of steps they accumulated, and where they exercised each day. Participants received program manuals in one of three formats: large print, braille, or uploaded onto an electronic device (for instance, an iPad).

Instruments

Fitbit Zip. Physical activity was measured by step counts and recorded by Fitbit Zips (Fitbit Inc., San Francisco, CA), a commercial tri-axial accelerometer that measures steps, distance traveled, and calories burned. Of several devices tested, researchers have found Fitbit Zip devices to have the least number of errors (1%) when recording steps of any commercial activity monitor (Guo, Li, Kankanhalli, & Brown, 2013). The participants used the same device throughout the study.

Social cognitive theory constructs. Five valid and reliable questionnaires were utilized to measure four social cognitive theory constructs (see Cervantes & Porretta, 2013, for validation and reliability information). Participants were able to choose how questionnaires were administered before and after the intervention (such as large print, electronically, or interviews). Participants 1 and 4 completed the surveys via interview, while participants 2 and 3 completed surveys via electronic platform (Google forms).

Social validity. Social validity was evaluated using written questionnaires. The questionnaires were administered following the completion of the intervention to four groups: participants, the physical education teacher, parents, and residential staff. The social validity questionnaires were administered following the completion of the intervention.

Design

The study utilized a single-subject, multiple-baseline design across participants. Baseline observations on the target behavior were collected for all four participants. When participants in the ninth-period class reached a stable state of responding, the intervention was introduced while participants in the other class remained at baseline. Typically, the treatment would only be introduced to the second class of participants when all participants in class one reached a stable state of responding in the treatment condition. However, no intervention effect was observed from participants in class one. Due to a potential non-effect and limited time line provided by the school, the researchers decided to implement the intervention to the second class (first period) without an intervention effect in the first class. The implementation of the intervention to the first-period classes prior to intervention effects in the first class violated fundamental rules of the multiple baseline design, limiting the ability to demonstrate a functional relation.

Data collection

Institutional review board (IRB) approval to conduct the study was obtained. In addition, parental permission and assent were obtained for all participants. After enrolling in the study, each participant completed the five social cognitive theory questionnaires. Questionnaires were completed again on the day following the last intervention lesson for a post-intervention comparison. After completing all questionnaires, participants received a tutorial on how to appropriately wear a Fitbit Zip and were asked to place it on their waistband on the middle of the anterior side of their thigh on the opposite side of their assistive devices.

Participants began wearing the Fitbit Zips the following afternoon. They were worn from 3:30 p.m. until 10:00 p.m. each day and during all after-school hours except when bathing or swimming. Each evening, participants removed their Fitbit Zips and placed them in their backpacks for the next day. The first author collected the instruments and synced data each afternoon. This protocol remained consistent throughout the baseline and intervention phases.

Treatment integrity

A treatment integrity checklist was developed for each lesson and was utilized to measure the degree to which the teacher provided the planned intervention. Treatment integrity was calculated by dividing the number of accurately implemented sections of the lesson plan by the total number of sections in that plan, multiplied by 100. After each lesson, the lead researcher and a second observer (a trained doctoral student) independently watched previously recorded lessons and completed a treatment integrity checklist. Interobserver agreement was calculated by dividing the number of agreements by the summation of agreements plus disagreements and multiplying by 100.

Data analysis

Line graphs of daily step counts were created for each participant and were evaluated through visual analysis. Graphical data were also analyzed for effect size estimates using the percentage of nonoverlapping data. The percentage of nonoverlapping data was calculated in the following four steps: (1) identify the highest data point in baseline, (2) count the number of data points in the intervention phase that exceeded the highest data point in the baseline phase, (3)

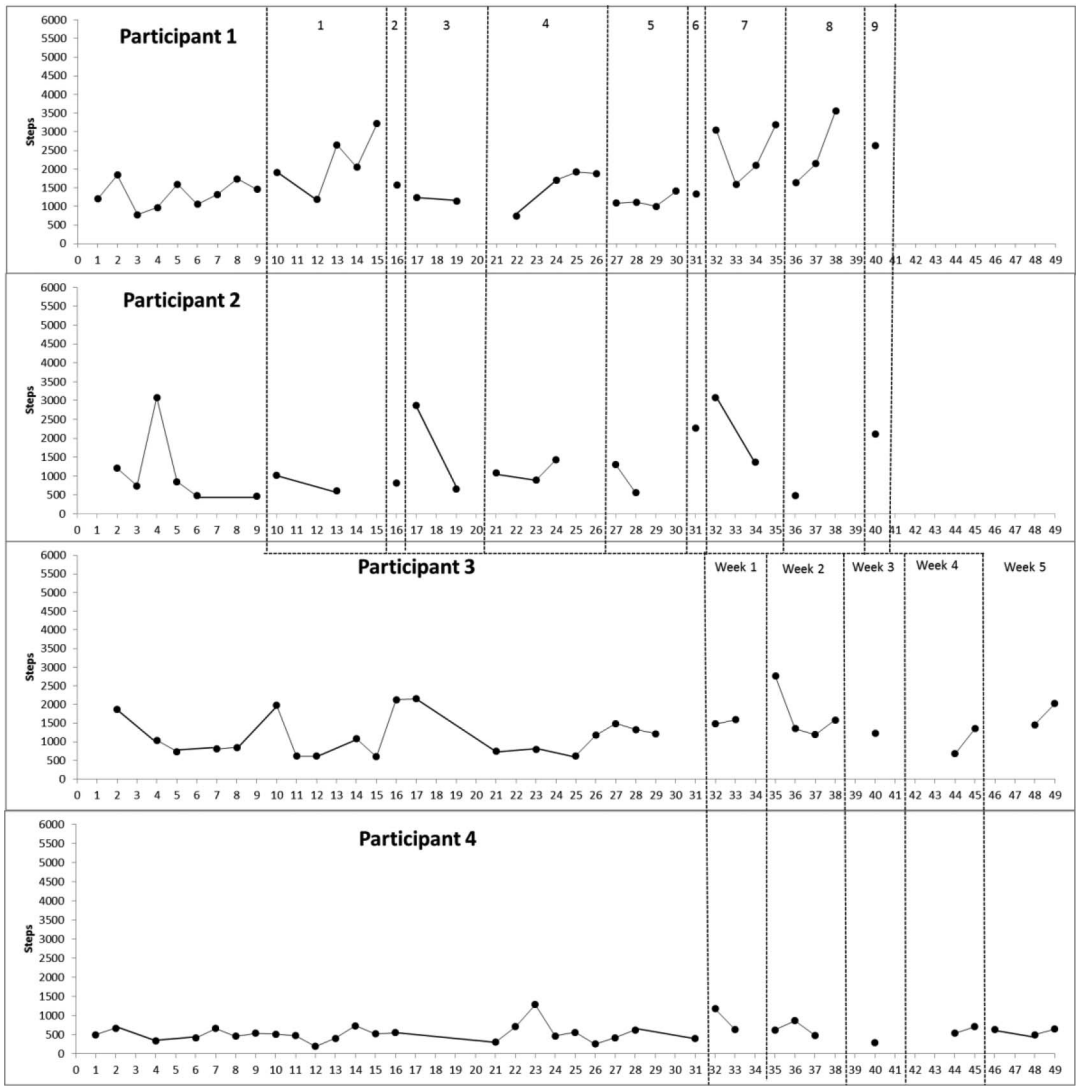

Figure 2. Step count data per session across participants. Phases for Participants 1 and 2 are designated by lessons. Phases for Participants 3 and 4 are designated by week.

divide that number by the total number of data points, and (4) multiply that number by 100 (Kratochwill et al., 2010). Social cognitive theory questionnaire data were analyzed descriptively and by comparing change in individual scores from baseline to post-intervention.

Results

Mean treatment integrity scores of 99.6% and 100% were obtained by the lead researcher and second observer, respectively, across program sessions. The overall mean interobserver agreement percentage across observers for all sessions was 99.8% (range 89–100). Based on the obtained mean scores, treatment integrity was found to be acceptable.

For all participants, experimental control was not obtained because there were no evident and consistent changes in steps during the intervention (see Figure 2). Some participants demonstrated temporary increases; however, these increases did not persist and

Table 3
Summary of directional change of baseline and intervention steps and social cognitive theory scales.

Participant	Item	Baseline	Intervention	Direction change
Participant 1	Steps (mean)	1328.4	1882	+(42%)
	Self-efficacy	24	32	+(33%)
	Social support	17	13	−(24%)
	Self-regulation	44	86	+(95%)
	Outcome expectancy values	196	287	+(46%)
	Self-efficacy—VI	36	45	+(25%)
Participant 2	Steps (mean)	1137.5	1371.7	+(21%)
	Self-efficacy	25	24	−(4%)
	Social support	8	11	+(38%)
	Self-regulation	43	71	+(65%)
	Outcome expectancy values	191	211	+(10%)
	Self-efficacy—VI	50	49	−(2%)
Participant 3	Steps (mean)	1151	1518	+(32%)
	Self-efficacy	28	29	+(4%)
	Social support	29	13	−(55%)
	Self-regulation	26	59	+(88%)
	Outcome expectancy values	319	264	−(17%)
	Self-efficacy—VI	57	44	−(23%)
Participant 4	Steps (mean)	527	644	+(22%)
	Self-efficacy	29	29	No change
	Social support	13	15	+(15%)
	Self-regulation	32	91	+(184%)
	Outcome expectancy values	206	218	+(6%)
	Self-efficacy—VI	42	47	+(12%)

Note: VI = visually impaired.

were not directly related to phase changes. Effect size estimates (percentage of nonoverlapping data scores) ranged from 0% (participants 2 and 4) to 48% (participant 1). Percentage of nonoverlapping data scores below 70% suggest that the intervention's effectiveness was questionable (Kratochwill et al., 2010). Table 3 provides a summary of directional step count changes and social cognitive theory mean scores and percentages for each participant. Moderate step count percentage increases ranged from 21% (participant 2) to 42% (participant 1) between baseline and intervention phases.

Social validity questionnaires were distributed to a total of 11 individuals (four participants, one physical education teacher, four parents, and two residential staff). Questionnaires were completed and returned by everyone except one parent (91% return rate). Responses support the program's social usefulness for enhancing leisure-time physical activity.

Discussion

Results suggest that the social cognitive theory–based intervention did not demonstrate a functional relation with the participants' target behavior (steps per day). This was evident in each participant's data, where high overlap between baseline and intervention data, and a lack of upward trends or level increases were found. Further, percentage of nonoverlapping data scores supported the lack of an intervention effect for each participant. Therefore, it was concluded that the intervention did not

have an effect on the accumulation of daily steps taken during leisure-time physical activity.

The results of this study conflict with the Cervantes and Porretta (2013) study. Although both studies sought to determine the intervention effects on the leisure-time physical activity of adolescents with visual impairments, differences between studies may have affected results. Specifically, the residential status of participants and time of year in which this study took place (winter) may have influenced the results. This study included participants who were either part-time or full-time day students, and low outdoor temperatures and icy conditions associated with the winter months in the Midwest may have reduced the number of opportunities they had to be physically active. Cold weather was discussed among all participants when describing barriers to being active during the intervention. This factor would not have been as much of a consideration for Cervantes and Porretta, since their participants were all of residential status and the study was conducted at a time of year with more favorable weather. In addition, because Cervantes and Porretta offered their program as an after-school program, it was likely to remain consistent across days and not be affected by changes in the school day. However, because the current intervention was embedded into a physical education course, it was dependent on the physical education class schedule. Therefore, instances in which statewide testing or other school-wide events altered the class schedule, in turn, affected the intervention schedule, creating variability in program delivery.

Because the study took place in a natural educational setting, a number of limitations were present. First, we had limited control over the duration of and the time of year in which the intervention took place. The school administration and after-school programming determined the intervention schedule. Thus, the original plan about when to introduce the intervention to the second class could not be maintained. Time limitations truncated the intervention for the second class. Another limitation was that the authors could not ensure the attendance of participants during data collection. During data collection, several schools were closed due to winter weather, thus affecting the attendance of our non-residential participants. This, in turn, influenced our ability to collect data and implement the intervention.

Conclusions

The results of this study suggest that the theory-based intervention did not have a functional relation with participants' physical activities. Negative findings, such as those found in this study, can provide valuable insight into the effectiveness of programs and provoke further research. Although negative, the findings presented here bring up the possibility that findings reported previously (Cervantes and Porretta, 2013) may have represented a type 1 error. Surely, additional research is necessary to explore that possibility. With the lack of physical activity research related to adolescent-aged individuals with visual impairments (Haegele & Porretta, 2015), and the influence that physical activity has on health-related outcomes (for instance, obesity), further research is needed for this population. We suggest that future research should examine: (a) the role social cognitive theory constructs play in influencing physical activity behavior, (b) the role of theory-based interventions in various weather conditions or seasons, (c) the amount of daily physical activity individuals with visual impairments typically complete during school and after school in order to determine the best time of day to promote physical activity, and (d) the relationship between the use of talking pedometers and walking behavior.

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