

An Investigation of the Motivational Effects of Talking Pedometers Among Children with Visual Impairments and Deaf-Blindness

Lauren J. Lieberman, Moira E. Stuart, Karen Hand, and Barbara Robinson

Abstract: This study sought to determine the effects of using a talking pedometer on walking behavior and the value placed on walking by 22 children who are visually impaired or deaf-blind. The results revealed that the children were motivated to set challenging goals for increasing daily activity levels through the feedback provided by the talking pedometers.

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In the past 30 years, the percentage of children who are overweight has more than tripled, partly because of the prevalence of decreasing levels of physical activity (Pangrazi, 2004). Unfortunately, children with disabilities generally have even lower levels of health-related fitness because of both physical and psychosocial constraints (Longmuir & Bar-Or, 2000). Research has consistently shown that individuals who participate in regular physical activity to improve health-related fitness have higher energy levels and lower their risk of heart disease, cancer, diabetes, osteoporosis, and other chronic diseases. In addition, regular participation in physical activity has also been found to improve psychological health and to lessen depression and anxiety (Kilpatrick, Hebert, & Jacobsen, 2002).

Review of the literature

PHYSICAL ACTIVITY BY CHILDREN WITH VISUAL IMPAIRMENTS

Although people who are visually impaired (that is, those who are blind or have low vision) use more energy during activities of daily living (Buell, 1982), they tend to have lower levels of physical activity and health-related fitness than do those who are sighted (Lieberman, Byrne, Mattern, Fernandez-Vivo, & Robinson, 2006; Lieberman & McHugh, 2001; Skaggs & Hopper, 1996; Wyatt & Ng, 1997). With adequate levels of fitness, children with visual impairments can participate in physical activities in many environments, including physical education classes, community programs, and family recreational activities (Hopkins, Gaeta, Thomas, & Hill, 1987). Participation in physical activities often depends on children's perceptions of their ability and competence to perform these activities (Robinson & Lieberman, 2004; Shapiro, Moffett, Lieberman, & Dummer, 2005). Perceptions of abilities and competence can be improved with greater levels of physical activity and health-related fitness.

GENDER

Research on the relationship among gender, physical activity, and levels of fitness in children and youths who are visually impaired has shown contradictory results. Some studies have found that the gap in physical fitness is generally greater between girls who are visually impaired and sighted girls than between boys who are visually impaired and sighted boys. Boys with visual impairments improve steadily from ages 6 to 17, whereas girls plateau at about age 13 or 14 (Winnick & Short, 1982, cited in Winnick, 1985). However, Lieberman and McHugh (2001) reported larger gaps between boys with visual impairments and sighted boys aged 9-19 in body mass index, arm strength, and abdominal strength than between girls with visual impairments and sighted girls. Kobberling, Jankowski, and Leger (1991) reported differences in

aerobic capacity between boys with visual impairments and sighted boys aged 12-18, but no differences between girls with visual impairments and sighted girls in this regard.

Studies of the influence of gender on physical fitness among children and youths with visual impairments have revealed no gender differences in $VO_{2\max}$ which is a measure of the maximum amount of oxygen that a person can take in and process during exercise (Sundberg, 1982). $VO_{2\max}$ is measured in millimeters of oxygen per kilogram of body mass per minute and serves as one measure of athletic potential. When the $VO_{2\max}$ was expressed on a body-weight basis, it was found that the $VO_{2\max}$ per kilogram of girls who were blind was significantly lower than that of boys who were blind. Lieberman and McHugh (2001) compared the passing rates of boys and girls with visual impairments on the Fitnessgram, a health-related, criterion-referenced fitness test that examines five areas related to health-related fitness: cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body mass. They found that the girls' passing rates exceeded the boys' by more than 10% for push-ups, curl-ups, body mass index, and shoulder stretch, and that the boys' passing rate exceeded the girls' by more than 10% in the one-mile run. However, the differences in passing rates were not significant.

THE USE OF PEDOMETERS TO DETERMINE PHYSICAL ACTIVITY LEVELS

Walking, one of the most common forms of leisure-time physical activity, is fundamental to daily activities and may be easily and accurately assessed (Stanish, 2004; Tudor-Locke, 2002).

Although pedometers provide immediate, continuous feedback by detecting vertical movement produced by each step taken while walking or running, they cannot measure the intensity, frequency, or duration of physical activity, also known as the FITT principle (frequency, intensity, time, and type) (Beighle, Pangrazi, & Vincent, 2001). Research on the reliability of pedometers for

measuring physical activity levels has found that compared to heart-rate monitors and several accelerometers, less measurement error occurred with pedometers (Beighle et al., 2001). Tudor-Locke et al. (2004) stated that four days of monitoring activity levels with pedometers is sufficient to determine the activity habits of children.

Stanish (2004) reported that there is significant evidence that walking 10,000 steps per day is similar to meeting the physical activity recommendations suggested by the Surgeon General. However, walking 10,000 steps per day does not necessarily mean that the recommended activity guidelines are being met. Beighle et al. (2001), Stanish (2004), and Tudor-Locke (2002) suggested that this target may be too challenging for individuals who lead sedentary lives, but may teach individuals of various abilities that activities performed throughout the day are just as important as shorter periods of activity. The actual recommendation for a healthy active lifestyle for children aged 6-12 is 12,000 steps per day for girls and 15,000 steps per day for boys (Tudor-Locke et al., 2004). The President's Council on Physical Fitness and Sports (2004) recommended 11,000 steps per day for girls and 13,000 steps per day for boys.

MOTIVATION TO BE PHYSICALLY ACTIVE IN CHILDREN

Harter (1978) developed a model of intrinsic motivation that helps to predict the motivational outcomes of mastery attempts in various achievement domains by children and adolescents. She found that a combination of enjoyment or intrinsic pleasure, perceptions of competence, and successful mastery attempts increase the motivation of children to continue to engage in mastery attempts. Critical to all mastery attempts by children is the opportunity to gain rewards and to learn to set mastery goals that are optimally challenging yet realistic. This model has been widely applied to the sports and physical activity domain with able-bodied children, and researchers have investigated the motivational constructs among children with disabilities. Children

who are visually impaired have often been denied the opportunity to set their own mastery goals, and their parents and teachers may protect them from attempting to perform certain physical activities (Robinson & Lieberman, 2004). Thus, it is likely that they do not enjoy certain physical activities because they have not experienced successful mastery attempts in the physical domain. However, it is critical for children with disabilities to have opportunities to develop competencies and to learn to value physical activity just as children without disabilities do. Walking is one physical activity that provides an optimal yet realistic challenge for children who are visually impaired.

One theory of motivation that includes these motives is Eccles et al.'s (1983) expectancy-value approach. This theory integrates personal and contextual variables to explain the choices that people make in achievement domains (such as education and sports). What is pertinent for this study is that the model also explicitly addresses the role of perceived ability and the larger cultural context in patterns of achievement and behaviors (Eccles, Wigfield, & Schiefele, 1998). The expectancy-value approach has been successfully applied to the sports domain with children and adolescents. Research has consistently demonstrated strong and significant relationships among expectations, value, and achievement behaviors (Dempsey, Kimiecik, & Horn, 1993; Eccles & Harold, 1991; see Eccles et al., 1998, for a review). However, to date little research has examined how children who are visually impaired develop a value for physical activity when intervention strategies are introduced to enhance motivation for physical activity.

Method

This study had two purposes. The first was to investigate the walking behavior of children with visual impairments who used a talking pedometer before and during their attendance at Camp Abilities, a summer sports camp for children with visual impairments. The second was to examine, through interviews, the

children's perceptions of the value and usefulness of physical activity, their interest in such activity, and the importance of the talking pedometer for increasing their levels of physical activity.

INSTRUMENT

The talking pedometer that was used in the study was a Brookstone Talking Pedometer. Before this pedometer was chosen, we purchased four talking pedometers and pilot-tested them for accuracy and durability. The Brookstone met the qualifications for accuracy, reliability, endurance, and accessibility.

PROCEDURES

The families or guardians of the participants were contacted one month before the start of the one-week summer sports camp to request the participation of their children. After each parent or guardian and child agreed to participate, a talking pedometer was sent to each home with instructions, together with a request for permission to take part in an interview when the child arrived at the camp. The parents were sent an informed consent letter, and only those children who returned this form were allowed to participate in the study. All procedures for this study were approved by the Institutional Review Board for the protection of human subjects of the State University of New York-Brockport prior to the collection of data.

Each parent was also sent seven daily logs to record the number of steps that his or her child took each day. Although four days are deemed adequate, seven days of wearing the pedometer are recommended (Tudor-Locke et al., 2004). The parent filled out each daily log with the amount of time the participant wore the pedometer, which ranged from 12 to 18 hours. The steps taken per day were recorded for each participant for the seven days prior to camp and the seven days of the camp.

PARTICIPANTS

The 22 participants (15 boys and 7 girls), who ranged in age from 9 to 13, attended the camp. Of the 22, 4 were totally blind (B1), 9 had travel vision (B2), and 9 were legally blind (B3). This B1-3 classification system is used by the United States Association of Blind Athletes (2006). In addition, 2 participants were also hard of hearing. The seven days prior to camp was the participants' last week of school, with a weekend at the beginning. According to the parents' reports, the type and amount of activities the participants engaged in during that week were typical of those they engaged in during most warm-weather weeks of the year.

Of the 14 participants who were interviewed from the total population of 22, 6 were boys and 8 were girls aged 10-12 years ($M = 11.6$, $SD = 1.7$), including the 2 who were also hard of hearing in addition to their visual impairment. Of the remaining 8 participants, 5 could not be interviewed because of their schedules, and 3 declined to be interviewed. We assumed that in the interviews, the children would be aware of their feelings toward the pedometer and walking as a form of physical activity and would be honest in sharing their experiences and beliefs about the pedometer.

An interview guide was developed to identify the children's beliefs about the value of walking as a form of physical activity and their perceptions of their competence with the talking pedometer. The questions were developed in accordance with the conceptual definition of subjective task value, which stipulates that value is a multidimensional construct consisting of a person's interest, the importance of achievement, and the perceived usefulness of an activity (Eccles et al., 1983). The interview guide was pilot-tested to determine the age appropriateness and appropriateness of the wording of the questions and the time needed to conduct the interviews. The results of the pilot interviews provided critical information that was used to develop and adjust the wording and order of the interview questions.

The interview consisted of such questions as "What does physical

activity mean to you?” “Do you walk as a form of physical activity: Why or why not?” and “How important is walking to you?” Sample questions regarding the children’s interest in using the talking pedometer included “Did you like the pedometer: Why or why not?” “Does using the pedometer make walking more interesting: Why or why not?” and “Would you use a pedometer if you had one of your own: Why or why not?”

All the interviews, which lasted an average of 25 minutes, were conducted by the third author at the camp in a conference room that was conducive to candid and uninterrupted conversations. The warm-up protocol for the interviews included reading the informed consent form, which provided information on the right to stop the interview at any time, the statement that there were no right or wrong answers to any question, permission to audiotape, and a statement concerning the confidentiality of their answers. Each child signed the form indicating his or her agreement to proceed with the interview.

The validity of the data was established in two ways. First, the pilot study was used to establish a developmentally appropriate and conceptually aligned interview guide, and second, the recorded answers were read back to the children a few days after the initial interview to provide respondent validation.

Descriptive analysis of the steps taken per day

Each of the 22 participants wore the talking pedometer for seven consecutive days prior to the camp. The intent of this portion of the study was to describe the naturally occurring number of steps that the children took each day. The parents were asked not to encourage their children to engage in any new activities or call any special attention to the talking pedometer. In addition, they were not encouraged to talk to their children about the fitness benefits of walking or the number of recommended steps per day or to encourage or develop a value for walking as a form of

physical activity. The parents documented the number of steps the children took each day.

The purpose of Camp Abilities is to develop motor and fitness skills in children who are visually impaired or deaf-blind and to encourage the children to maintain an active lifestyle after they leave the camp. The aim of using a talking pedometer in this study was to help the children realize their potential in terms of walking behavior. The fact that the average number of steps they took at home was approximately 9,000 and rose to 15,000 at the camp indicated that the use of the pedometer helped motivate each child to set higher goals and to realize his or her potential. Thus, we sought to create a motivational climate (Harter, 1978) that would encourage the children to take 15,000 steps per day. From the first day of camp, the adults (the researchers, counselors, and director) talked to the children about the standards for walking a set number of steps and the benefits of walking. The children had learned through physical education the benefits of walking, but had never been offered the use of a pedometer, let alone a talking pedometer. At this camp, the distance from the dormitory to the athletic facility was four-tenths of a mile, which the children had to walk four times a day (twice each way). In addition, the activities offered at the camp, such as track and field, beep baseball, goal ball, and tandem biking, promoted participation in physical activity. It is important to note that the participants had to take the pedometers off during judo, swimming, and gymnastics.

Thus, the goal of accounting for the number of steps taken in camp was to determine, in a descriptive manner, any notable changes in the number of steps. The 22 participants walked an average of 9,743 steps per day, with a range of 3,436 to 16,166, during the week before they went to the camp. The 7 female participants had a mean of 9,686 steps per day, with a range of 3,885 to 13,874, and the 15 male participants had an average of 9,770 steps per day, with a range of 3,437 to 16,166. As we mentioned earlier, this was a typical week of school with a

weekend included. The participation in activities is believed to be typical during most warm-weather weeks of the year.

At the camp, the 22 participants walked an average of 15,793 steps per day, with a range of 8,923 to 28,427. The 7 female participants walked an average of 14,663 steps per day, with a range of 8,923 to 22,200, and the 15 male participants walked an average of 16,321 steps per day, with a range of 9,752 to 28,427. The mean number of steps per day rose from 9,686 during the week before camp to 14,663 during camp for the 7 female participants and from 9,770 during the week before camp to 16,321 during camp for the 15 male participants.

QUALITATIVE RESULTS

A semi-inductive content analysis was used to group raw-data quotations (quotations or paraphrased quotations that captured the major ideas that were conveyed in the interviews) into lower- and higher-order themes (Patton, 1990). The qualitative researcher, the third author, organized the data by reading the transcriptions repeatedly (familiarization), identifying raw-data themes from specific quotations, and organizing these raw-data themes into interpretable and meaningful themes using inductive procedures. An inductive analysis was used to group common raw-data quotations that all the researchers agreed on. These quotations formed the basis of the labels that were created for the themes (Patton, 1990).

ANALYSIS OF THE INTERVIEWS

The sample of participants was considered homogeneous. All the participants had similar disabilities, were of similar ages, and wore the talking pedometer during the last week of school. The majority of the children had similar reactions to the pedometer and perceptions of the value of walking as a form of physical activity.

The theoretical analysis of the data described the value of

walking, conceptualized as having three distinct general components: an interest in and the importance and usefulness of an activity. However, several participants stated that the pedometer seemed useful because it was interesting. Specifically, this portion of the study revealed four themes: achievement of goals, health and fitness, independence, and transportation.

Achievement of goals

One essential aspect that led to value being placed on walking was the feedback on steps, which allowed the participants to know they achieved their goal. The children were highly interested in and motivated by the talking pedometers that provided feedback on the number of steps taken per day. As a result of using the pedometers, they seemed to gain a better understanding of the connection between the required number of steps taken per day and the health benefits of walking. The feedback also provided essential information to the children that allowed them to set more challenging goals from day to day. Some camaraderie was created through friendly competition among the campers. For most children, the pedometer was an effective tool for achieving goals for increasing daily steps (activity). Some comments in support of this finding were these: “[The pedometer] can tell you how many steps you have walked, so you can improve, and you can start trying for a higher step goal” and “It helps you to know how many steps you want to take tomorrow, and you [reach the goal] and you feel good.”

Health and fitness

Health and fitness benefits were the second most common theme. Most children were aware of the potential health and fitness benefits of walking. They understood the connection between taking a greater number of steps and their increased involvement in physical activity. Several children placed value on walking because they thought they could become stronger. This attitude also drove their goal setting. This theme was supported by the following comments:

[It's] very important because you are supposed to be healthy.

I think walking is a good thing; it really helps you to grow, and it is a good exercise.

You're supposed to walk 10,000 steps a day; that's what the Chinese do.

I want to go for a walk because I want to put in more than 10,000 steps. The other day I did 17,000 and something, and I was like, "Yeah!"

Independence

A few participants reflected upon the sense of independence that they gained from walking. The following comments emphasized this point: "I love my pedometer; it's interesting because it helps me be independent" and "It makes me realize I do not have to wait around for a ride; I can get places by myself."

Transportation

The theme of transportation was a positive outcome of the study, given that children who are visually impaired know that they will be unable to drive and must rely on themselves or others for transportation. The participants accepted their need to be independent travelers, and the pedometers showed them that they could use walking as a mode of transportation. This acceptance and belief can be seen in the following comments: "It is important so that you can get to places that you want to go"; "[Walking is important] because I can get from place to place without hurting the ozone layer"; and "[Walking is important] because it is a means of transportation; it gets you places."

It was evident that the talking pedometers had an impact on the participants' levels of independence, knowledge of health and fitness, goal setting and achievement, and transportation.

However, the long-term impact of the talking pedometer on the participants' levels of physical activity once they left the camp is not known.

Discussion

The first purpose of this study was to determine the number of steps taken per day by the male and female participants. It was noted that the average for all the participants was 9,743 steps per day, with a range of 3,436 to 16,166--a range that is lower than Tudor-Locke et al.'s (2004) recommendations of 12,000 steps per day for girls aged 6-12 and 15,000 steps per day for boys aged 6-12 and the recommendations of the President's Council on Physical Fitness and Sports (2004) of 11,000 steps per day for girls and 13,000 steps per day for boys. Although the participants' age range (9-13) was higher than 6-12 years, the recommended steps would still be considered healthy for them. In addition, the average steps for the girls (9,686) and boys (9,770) in this study were far below the recommended 11,000-15,000 steps per day.

The average number of steps per day during the week of camp was 15,793, with a range of 8,923-28,427 ($SD = 4,396$). The 7 female participants walked an average of 14,663 steps per day, with a range of 8,923 to 22,200, whereas the 15 male participants walked an average of 16,321 steps per day, with a range of 9,752 to 28,427. The nonsignificant differences between the number of steps per day taken by the boys and girls indicates that there is no need to structure walking activities differently for boys and girls.

That the participants had lower levels of walking behavior than the recommended number of daily steps per day may have several causes. Several reviews of the literature on barriers to physical activity have found that a major barrier is the lack of professional preparation of physical education teachers (see, for example, Lieberman, Houston-Wilson, & Kozub, 2002; Stuart, Lieberman, & Hand, 2006). It has been well documented that successful experiences of physical activity for children with disabilities are contingent on factors that are related to teachers' preparation and attitudes, as well as the perceived and actual barriers to instruction (Folsom-Meek, Nearing, Groteluschen, & Krampf, 1999; Hodge & Jansma, 1999). In addition, Longmuir and Bar-Or (2000) reported that youths with visual impairments had the most

sedentary lifestyles of those with many other disabilities. Buell (1986; see also Nixon, 1988; Sherrill, Rainbolt, & Ervin, 1984) contended that children who are visually impaired have limited opportunities to be active because of the misconceptions of others. That is, because of their lack of knowledge, parents and teachers often overprotect these children because they are afraid that the children will be injured if they participate in physical activities.

It is interesting that the two participants who were deaf-blind benefited equally from using the talking pedometers. These children could not hear the number of steps when the pedometers were on their waists, but when they held the pedometers up to their ears, they could hear the voice with their hearing aids. In addition to the information found in the quantitative portion of the study, the interviews revealed several benefits of the use of talking pedometers, as was mentioned earlier, in the areas of goal achievement, health and fitness, independence, and transportation.

Conclusion

This study found that the 22 participants with visual impairments (that is, low vision, blindness, and deaf-blindness) took fewer steps per day than the recommended level for healthy living in the week prior to attending the summer sports camp. However, during the week that they attended the sports camp, the number of steps they took per day was equal to or exceeded the recommended number of steps (Stanish, 2004). It is recommended that future studies be conducted on the usefulness of talking pedometers for children with visual impairments, as well as other physical activity assessments and interventions, to encourage higher levels of physical activity among this population.

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Lauren J. Lieberman, Ph.D., professor, Department of Physical Education, College at Brockport, State University of New York, 350 New Campus Drive, Brockport, NY 14420; e-mail: <llieberm@brockport.edu>. **Moira E. Stuart, Ph.D.**, associate professor, Department of Kinesiology and Physical Education, Northern Illinois University, Anderson Hall 221, DeKalb, IL 60115; e-mail: <mestuart@niu.edu>. **Karen Hand, M.S.**, instructor, Department of Kinesiology and Physical Education,

Northern Illinois University; e-mail: <khand@niu.edu>.

Barbara Robinson, M.S., adaptive physical education teacher,
Siletz County Public Schools, 4400 Northwest Walnut Boulevard,
Unit 31, Corvallis, OR 97330; e-mail:
<barbsiletzschool@yahoo.com>.

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