

Increasing Physical Activity in Individuals With Autism

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This study investigated the outcomes of an intervention package on participation in two physical activities: snowshoeing and walking/jogging. Three male secondary school students who had been diagnosed with autism and were attending a school for students with intellectual disabilities participated in a 6-month outdoor physical activity program. The authors used a changing conditions design; the program was divided into six phases by the amount of edible reinforcers provided during sessions. A self-monitoring board, verbal cuing, and edible reinforcers were used in the study. Distance snowshoed, walked, and jogged per 30-min session increased as edible and verbal reinforcement decreased. The results suggest that interventions can be developed to promote sustained participation in physical activity for individuals with autism.

Physical activity is an important part of a healthy lifestyle for all people (U.S. Department of Health and Human Services, 1996) but is often overlooked in people with severe disabilities (Ellis, Cress, & Spellman, 1992), including those with autism spectrum disorder (ASD). Motor functioning of individuals with ASD has been a neglected area (Baranek, 2002; National Research Council, 2001) despite the fact that participation in physical activity has been shown to have multiple benefits, including reduction of stereotypic behavior (Levinson & Reid, 1993; Prupas & Reid, 2001), increased appropriate responding (Kern et al., 1998), and the potential for social interaction (Berkeley, Zittel, Pitney, & Nichols, 2001). The number of individuals being diagnosed with ASD is increasing (Wing & Potter, 2002), and many teachers and coaches are—or soon will be—including children with ASD in their programs. Therefore, empirical research that validates instructional methods and establishes programming guidelines to enhance physical activity participation is needed.

Educators and researchers are more and more recognizing that motor functioning is a deficit area for children with ASD. Parents have noted motor delays in infants with ASD as early as 6 months to 9 months of age (Baranek, 1999; Ornitz, Guthrie, & Farley, 1977). The performance of children with

autism on standardized motor tests tends to fall below average. Berkeley et al. (2001) examined the locomotor and object control skills of children ages 6 years to 8 years who had autism. Seventy-three percent of the participants scored in the poor and very poor performance categories of the *Test of Gross Motor Development* (Ulrich, 1985). Ghaziuddin and Butler (1998) reported that children 8 years to 15 years of age who had been diagnosed with autism scored lower on the *Bruininks-Oseretsky Test of Motor Proficiency* than peers who had been diagnosed with Asperger syndrome and pervasive developmental disorder—not otherwise specified (PDD-NOS). All three groups scored lower than general population norms. Ghaziuddin and Butler reported the IQ scores for the three groups: The autism and PDD-NOS groups each had a mean Full-Scale IQ of 78, and the Asperger group had a mean Full-Scale IQ of 105. When the authors adjusted the gross-motor test scores for IQ, there was no significant difference among the three groups. This suggests that intellectual function may have an impact on motor performance. Manjiviona and Prior (1995) found that children with high-functioning autism scored lower on motor skills than children with Asperger syndrome, although both groups performed below age-appropriate norms. Thus, the available evidence converges on a conclusion of poor motor functioning associated with ASD, particularly for individuals with autism (Baranek, 2002; Reid & Collier, 2002; Smith, 2000).

Participation in physical activity is often a challenge for people with autism because of poor motor functioning and low motivation (Koegel, Koegel, & McNeerney, 2001; Reid, O'Connor, & Lloyd, 2003), difficulty in planning and generalization (Ozonoff, Strayer, McMahon, & Filloux, 1994; Renner, Klinger, & Klinger, 2000), and difficulty in self-monitoring (Hughes, Russel, & Robbins, 1994). Promoting physical activity with complex motor skills (e.g., golfing, soccer) is likely to be problematic. In addition, team activities may be contraindicated for some individuals owing to social interaction and physical skill requirements. Physical activities that do not require team environments or high skill levels thus may be more appealing to individuals with autism.

Sedentary lifestyles are commonplace for individuals with intellectual disabilities (Draheim, Williams, & McCubbin, 2002), and fitness levels for this population have been found to be lower than for the general population (Ellis et al., 1992; Gillespie, 2003). Few studies have reported fitness levels of adolescents and adults with severe autism, despite the fact that the majority of individuals with autism also have an intellectual disability (Fombonne, 2003), and one would therefore expect low fitness and activity levels in this population also. Programs that utilize simple motor activities and encourage sustained participation should be investigated. In *A Report of the Surgeon General: Physical Activity and Health*, the U.S. Department of Health and Human Services (1996) suggested that 30 min of moderate to vigorous physical activity is necessary to acquire substantial health benefits. Encouraging individuals with autism to be physically active for 30 min at a moderate level may prove challenging, however.

Strategies that combine external reinforcement, self-monitoring, and verbal cuing from adults may be effective for encouraging sustained engagement in physical activity for people with autism. External reinforcers may motivate students to initially participate in an activity and may then be replaced by internal operants to promote independence (Firman, Beare, & Loyd, 2002; Hughes et al., 2002). The term *self-monitoring* refers to systematically observing one's behavior and recording the occurrence or nonoccurrence of a specific response in some way. During self-monitoring, two actions occur: self-observation and self-recording. Self-monitoring promotes independence and increases participation but is seldom taught or followed in educational programs (Agran et al., 2005; Hughes et al., 2002) and is rarely used in physical education. Much of the existing research on self-monitoring has focused on typically developing students and individuals with mild disabilities. Lombard, Lombard, and Winett (1995) and Weber and Wernheim (1989) found that self-monitoring in conjunction with prompting and extra attention increased participation in exercise programs for individuals without disabilities over a 4- to 6-month period. Unfortunately, little research has been conducted on self-monitoring for students with autism and severe intellectual disabilities (Ganz & Sigafos, 2005), although this strategy has the potential to increase student participation in educational settings (Agran et al., 2005). In one of the few available studies, Agran, Snow, and Swaner (1999) found that only 35% of special education teachers they surveyed taught self-monitoring skills, and far fewer—only 3%—reported observing their students using these skills. Research on the use of self-monitoring strategies in the area of physical activity for people with autism is extremely limited; investigation is required to determine if self-monitoring will increase student participation.

Teaching and encouraging self-monitoring of an exercise program may be one method of promoting a physically active lifestyle for individuals with autism. In this study, we investigated the impact of an intervention program that included edible reinforcement, verbal cuing, and self-monitoring on

sustained physical activity of adolescents and a young adult with autism.

Method

Participants

Three young men, who ranged in age from 15 years to 20 years and were enrolled in a Canadian school for individuals with severe disabilities, participated in a snowshoeing and walking/jogging program. Each young man had a primary diagnosis of autism, was nonverbal, and engaged in a high degree of stereotypic behaviors. The school director had recommended them as participants on the basis of three criteria: ability to perform the physical activity, including going outside during the winter; the classroom teacher's belief that the student would benefit equally from the physical activity as from a classroom activity; and parental consent. The school had no formal physical education program. Although four students were initially recruited, one student removed his boots and socks when he arrived at the park where the program was to be conducted, and because of safety concerns, including fear of frostbite, he did not participate in the physical activity program.

Each of the three individuals who participated had been diagnosed as having autism according to the guidelines of the *Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV)* (American Psychiatric Association, 1994) and had also been categorized under this disorder according to the *Guide de la Déclaration d'Effectif Scolaire des Jeunes en Formation Générale (DCS)* (Ministère de l'Éducation de Québec, 1996). The DCS is a Quebec provincial government document that categorizes disabilities into codes to facilitate educational services. The code for autism is given to participants who meet *DSM-IV* criteria for autism as diagnosed by a psychiatrist in conjunction with a multidisciplinary team. Although specific details of the participants' cognitive abilities were not available, all young men attended a school for students with intellectual disabilities, as noted previously, and we therefore considered all three participants to have autism and intellectual disability.

The three participants attended two classrooms within the school. Each classroom used a structured teaching approach based on the Treatment and Education of Autistic and Related Communication-Handicapped Children (TEACCH) program (Schopler, 1994). The participants received edible reinforcement and verbal cuing in the classroom on a similar basis as used in this study but were not familiar with self-monitoring systems.

Tom was 16 years old. He was generally happy, enjoyed outdoor activities, and engaged in a high degree of stereotypic behaviors, such as hand flapping, swallowing air, running water over his hands and face, and vocalizations (high-pitched humming). Tom self-mutilated by scratching his face, hands, and lower arms until they bled. He was able to follow the class-

room schedule and work independently if the work material was organized. He was nonverbal and used pictograms efficiently to communicate his needs.

Mike was 20 years old. He was engaged in a number of stereotypic behaviors that interfered with other activities, including hand flapping and finger movements, echolalia and yelling, ripping plastic bags, pacing, walking in a particular pattern, and throwing items. Mike's parents and classroom personnel reported that Mike was often anxious, as evidenced by an increase in the following behaviors: pacing, ripping plastic bags, throwing items, opening and closing his fists, and pushing other people. His anxiety was also reflected in physical appearance changes, notably, his eyes were wide open, facial muscles were tense, and his rate of breathing increased and was audible. Although echolalic, he did not use words in a functional manner, and he communicated with the use of pictograms while in school. Mike was in good physical condition and enjoyed being outside.

Robert was 15 years old and had multiple disabilities, including autism, intellectual disability, and congenital fiber-type disproportion (CFTD). CFTD is a physical disability characterized in part by congenital hypotonia, respiratory difficulties, skeletal deformities, and delayed motor milestones (ter Laak et al., 1981). Robert displayed several stereotypic behaviors on a regular basis: hand flapping, head banging and rolling, and self-hitting. Robert also displayed aggressive behaviors, such as slapping, pinching, and kicking others. Both parents and classroom personnel reported that Robert was often anxious; this was characterized by withdrawal from the physical presence of others, increased rocking, self-hitting and head-banging, and increased striking of staff. At the same time, Robert would have audible respirations and lack of eye contact. Robert enjoyed being outside, especially once the weather was warm. He was nonverbal, could follow a schedule quite well, and was becoming adept at communicating with the use of pictograms.

Activity

Two culturally normative activities that were weather dependent—snowshoeing and walking/jogging—were carried out at a local park. Snowshoeing was the first part of the program and ran for 9 sessions. It was followed by walking/jogging for 23 sessions. The activities were performed outdoors and reflected seasonal changes. Snowshoeing, which occurred from January until March, is a common activity in Canada and is a fun way to exercise outdoors during the snowy winter months. In this study, snowshoeing was conducted on a flat area (such as a soccer field), making it a low-skill activity. In addition to physical exercise, we believed that participants would benefit from learning an activity that is readily available, is inexpensive, and can be done outside of school. This activity was new to the participants, and verbal support was required during the snowshoeing sessions. For safety reasons, we cancelled sessions when outdoor temperatures fell below -18 degrees Celsius (-0.4 F) or when the field was icy due to freezing rain. We

had to cancel 8 snowshoeing sessions, leaving a total of 9 opportunities to snowshoe.

The program changed to walking/jogging when the snow melted. The walking/jogging program began in late March and continued until the end of the school year and took place in the same park and on the same circuit as snowshoeing. Walking and jogging are low-skill activities, require little equipment, and can be engaged in almost anywhere, thus encouraging an active lifestyle. The walking/jogging activity occurred inside the school on rainy days.

Activity Circuit

We used a diamond-shaped (57 m \times 50 m) circuit within the boundaries of a standard soccer field. The start/finish point of the circuit was a permanent bench midway along one side of the soccer field. The self-monitoring board was placed on the bench. The remainder of the circuit was marked by three flagpoles (1.1 m high) with four flags each: yellow, green, red, and blue. We placed one flagpole opposite the start/finish point on the other side of the soccer field, and each of the other two flagpoles in front of the goal at each end of the field.

The activity took place twice a week at the park when weather was cooperative and inside the school on three rainy days (Sessions 18, 23, and 24). When the activity took place inside, we set the self-monitoring board and the three flagpoles in each corner of the school physical activity area. Each circuit was 53 m, approximately one quarter of the total circuit distance at the park; therefore, four indoor circuits equaled one outdoor circuit. All of the participants followed the indoor circuit easily.

On three occasions the soccer field was not available, so we set up the circuit in an alternative area of the park. The self-monitoring board and flags marked the circuit. We set the flags 54 m apart, and the circuit equaled the distance covered in one circuit of the soccer field. As a result, distance was recorded in the same manner as when using the circuit in the soccer field. The participants initially required additional verbal directives to follow this circuit but became more independent with time.

Intervention

The intervention consisted of three main components: self-monitoring board, edible reinforcement, and verbal encouragement/directions. Each is described separately.

Self-Monitoring Board. The participants recorded each completed circuit by placing a happy face that was 7.6 cm in diameter on a rigid foam board under their name, as shown in Figure 1. We had designed the markers and self-monitoring board using the colors assigned each participant in their TEACCH-based classroom. The rigid foam board measured 50.8 cm \times 76.2 cm. We divided the recording board into three vertical sections, one for each participant, and the individual participant's name was written at the top of his section in the



FIGURE 1. Self-monitoring board.

appropriate color. Participants placed one happy face marker per completed circuit under their name, coordinating the color with the color in which the name had been written.

To accommodate for the smaller space on the days that the activity took place in the school physical activity area, we created an intermediate recording board, using small (10 cm × 30 cm), laminated self-monitoring cards with four Velcro dots for each participant. The students placed one happy face marker per completed circuit on the individual board. When the board had four happy face markers, we removed them and placed one happy face marker on the larger self-monitoring board used at the park and soccer field.

Edible Reinforcement. During the physical activity program, we gave the participants edibles they preferred (Gummie Bears, chips, and gumballs) as recommended by the classroom teacher. This was consistent with classroom practices. Following four baseline sessions during which no edible reinforcement was given, we provided reinforcers every quarter circuit for four sessions, that is, one edible as each participant reached each corner on the diamond circuit. We provided these reinforcers on a decreasing basis during the program, at a rate of one every four sessions, until one reinforcer per complete circuit was reached. At this point, the participants continued to receive one reinforcer when they placed their happy face marker on the self-monitoring board. We followed this protocol for the remainder of the program until the final four sessions, during which no edible reinforcement was offered. The use of edible reinforcers such as candy may appear contraindicated in the quest for an active lifestyle, but the school personnel requested we use candy so that there would be continuity between the school program and the physical activity

program. Because the activity was carried out during school hours, we believe it was important to cooperate with the school personnel.

Verbal Cuing. Verbal cuing, in the form of encouragement and direction, was provided to participants by school staff members who accompanied the young men during the physical activity program. Verbal cuing was not systematically manipulated but varied at the discretion of the researcher or the teaching assistant who accompanied the participant. We defined *verbal encouragement* as statements intended to provide motivation to continue exercising, such as “Good job,” “Bravo,” and “You are a champion.” We asked the staff members to give encouragement during the circuit if the participants slowed down or stopped moving. Verbal encouragement was also given to increase the pace of the participants and to congratulate them on a completed circuit. We defined *verbal directives* as statements used to direct participants around the circuit and to redirect them if they wandered out of the circuit or forgot to touch a flagpole. Staff members wore portable microphones every third session and recorded the verbal encouragement and directives. We used event recording (van der Mars, 1989), in which each verbal directive or statement of encouragement is recorded as a single event, to count the number of events per session.

Procedure

The program was carried out on Tuesday and Friday afternoons. Each session lasted 1 hr and was scheduled into the participants’ weekly schedule. The first 15 min consisted of dressing in outdoor clothing and walking to the park, which was located 0.45 km from the school. The actual snowshoeing or walking/jogging program occurred for 30 min. The final 15 min of the hour consisted of walking back to the school and putting away outdoor clothing and equipment. On the three occasions when the activity was conducted inside the school, the participants came to the physical activity area, walked and jogged for 30 min, and then returned to their classrooms.

The researcher and two classroom teaching assistants accompanied the participants to the park. Upon reaching the park, the researcher asked the participants to begin the exercise activity, usually by saying, “Let’s go! How many circuits can we do today?” The participants snowshoed, walked, or jogged around the circuit, touching each flagpole as they completed each section. The researcher and teaching assistants moved around the circuit, providing assistance and encouragement if needed. As noted previously, the participants recorded each completed circuit by placing a happy face marker on their self-monitoring board.

The participants were instructed in snowshoeing prior to the beginning of the program, and they were invited to snowshoe in the schoolyard four times before the program began. The researcher helped the participants put on the snowshoes

and adjusted the harnesses to fit each individual's boots. In addition the researcher or school staff members helping with the program made sure that the harnesses were fastened correctly. The researcher told the participants to stand up on the snowshoes and then stood in front of each participant, holding both his hands and encouraged each person to take big steps. When the participant was able to maintain his balance while walking with the snowshoes, the researcher moved to his side, holding one hand for balance, if required. By the end of these four practice sessions, all of the participants were able to walk on snowshoes independently, although they required assistance to stand up if they fell.

Use of the self-monitoring board was new to all the participants. We introduced this board at Session 5. At the beginning of the session, the researcher showed the board to each participant and showed him how to place a happy face marker under his name each time he passed the start/finish point. The primary researcher greeted each participant as he approached the start/finish point, gave him a happy face marker of the correct color, directed him to the self-monitoring board, and used hand over hand to help him put the marker on the board. This procedure was carried out for three sessions, after which the participants usually put the marker on the board independently. Throughout the program, one school staff member or the researcher would remain near the self-monitoring board, give each student a colored happy face marker as he approached, and provide prompting as required to accomplish placement on the board.

Design

We used a changing conditions design to judge the effectiveness of the intervention package during physical activity (Alberto & Troutman, 2006). Conditions were predetermined (Kennedy, 2005). We divided the program into three conditions: baseline (Condition A), self-monitoring and verbal cuing plus edible reinforcers (Condition B), and self-monitoring and verbal cuing of the physical activity without edible reinforcers (Condition C). The changing conditions design allows the effects of several interventions to be investigated. This design can also be used to examine the effects of fading reinforcement, as seen in Condition B. Although functional relationships cannot be established without replication of each intervention, the effects of various interventions on behavior can be documented (Alberto & Troutman). In addition, this type of design has been used in research with students with disabilities (Stafford, Alberto, Fredrick, Heflin, & Heller, 2002).

We divided the second condition, which included the edible reinforcers, into four phases characterized by decreasing edible reinforcers from four per circuit (Phase 1: Sessions 5–9), to three per circuit (Phase 2: Sessions 10–13), two per circuit (Phase 3: Sessions 14–17) and one per circuit (Phase 4: Sessions 18–24) until the participants entered into the third condition. In the final condition, the participants continued

self-monitoring and receiving adult cuing but did not receive edible reinforcers. Tom completed four sessions in the final condition; Robert and Mike participated in only three sessions because they were away 1 day for a field trip.

Data Collection and Interobserver Agreement

The researcher recorded the number of circuits completed by each participant at the end of each session according to the number of smiley faces that had been placed on the self-monitoring board. Students were encouraged to finish a circuit once it was begun, so no fractional circuit data occurred. Because adults monitored the students' completion of the activity circuit, we did not collect additional reliability data. To determine the reliability of the data collected on the adults' verbal cuing, we did calculate interobserver agreement (Kennedy, 2005) for classifying statements as consisting of encouragement or directions. This was done by having a second rater listen to 38% of the audio recordings. Reliability was 97% for verbal encouragement and 93% for verbal directives.

Results

Distance Snowshoed/Walked/Jogged

Participants snowshoed for 9 sessions, 4 during baseline (Condition A), 4 under Condition B, Phase 1 (four reinforcers per circuit), and 1 session in Phase 2. All of the participants increased the number of circuits completed. Walking/jogging began at Session 10 and continued through Session 28. All of the participants increased the distance walked/jogged over the course of the program. Walking/jogging began in Condition B, Phase 2 (three reinforcers per circuit), and continued through Phases 3 and 4 and Condition C.

Figure 2 shows the distance snowshoed/walked/jogged by Tom. Snowshoeing distance increased by 0.2 km over 9 sessions. The distance Tom walked/jogged increased from 0.84 km to 2.1 km, an increase of 1.26 km over 21 sessions, while the use of edible reinforcers decreased.

Mike increased the distance he snowshoed by 0.2 km over the first 9 sessions. He doubled the distance walked/jogged from 1.14 to 2.28 km, an increase of 1.14 km over the remaining 17 sessions. Figure 3 displays a systematic decrease in edible reinforcers accompanied by a substantial increase in distance walked/jogged by Mike.

Figure 4 shows the number of circuits snowshoed and walked by Robert. Snowshoe distance doubled over the first 9 sessions, moving from an average of 0.2 km completed per baseline session to 0.4 km during Condition B, Phase 1 (four edible reinforcers). Distance walked increased from 0.41 km to 1.24 km in 30 min over the following 16 sessions. Robert achieved less overall distance than the other two participants, likely due to a mild physical disability, but nonetheless in-

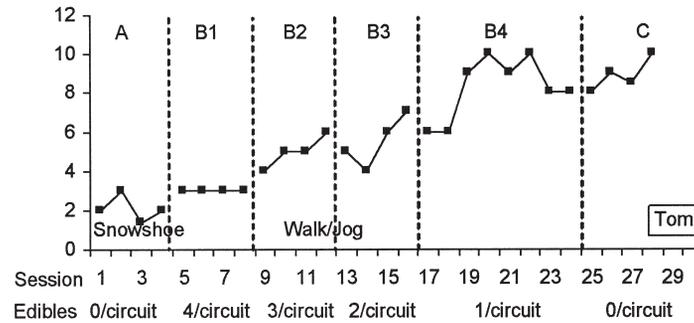


FIGURE 2. Distance Tom snowshoed/walked/jogged over 28 sessions. During Condition A, baseline, Tom did not self-monitor his distance and received no edible reinforcers. Under Condition B, Tom self-monitored his distance and received edible reinforcers. Condition B was divided into four phases, depending on the number of edible reinforcers: four, three, two, and one. Self-monitoring continued during Condition C, but no edible reinforcers were provided.

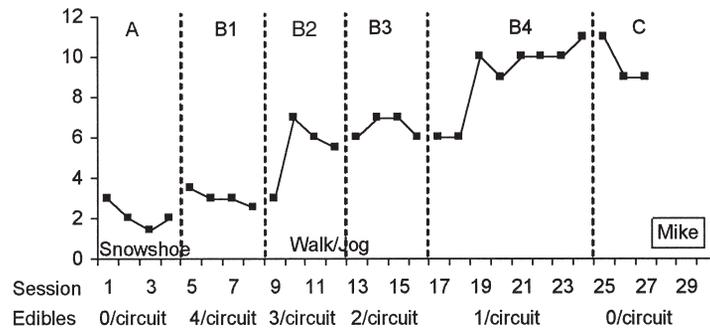


FIGURE 3. Distance Mike snowshoed/walked/jogged over 28 sessions. During Condition A, baseline, Mike did not self-monitor his distance and received no edible reinforcers. Under Condition B, Mike self-monitored his distance and received edible reinforcers. Condition B was divided into four phases, depending on the number of edible reinforcers: four, three, two, and one. Self-monitoring continued during Condition C, but no edible reinforcers were provided.

creased the distance consistently over the course of the program. Robert also missed several sessions in Phase B4 because of illness.

Verbal Cuing

The frequency of verbal encouragement and directives decreased over the duration of the program, as shown in Figure 5. We collected verbal data during 18 sessions throughout the program. At Session 7, both verbal directives and encouragement decreased dramatically after snowshoeing. This was likely a result of the nature of the activity. As previously noted, snow-

shoeing was a new activity during which staff members gave participants much guidance and encouragement. In addition, the participants were learning to negotiate the circuit during the snowshoeing activity, and this may have resulted in more verbal directives. Verbal encouragement continued to decrease more slowly over the walking/jogging program. However, Session 11 was very high in verbal encouragement owing to the commencement of jogging during the session. Distance walked/jogged during the sessions continued to increase despite the reduction in verbal encouragement.

Verbal directives remained fairly stable, with a slight decline throughout the walking/jogging program. A peak in the

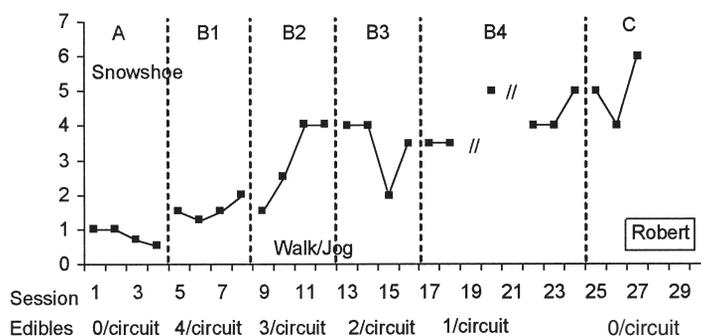


FIGURE 4. Distance Robert snowshoed/walked/jogged over 28 sessions. During Condition A, baseline, Robert did not self-monitor his distance and received no edible reinforcers. Under Condition B, Robert self-monitored his distance and received edible reinforcers. Condition B was divided into four phases, depending on the number of edible reinforcers: four, three, two, and one. Self-monitoring continued during Condition C, but no edible reinforcers were provided.

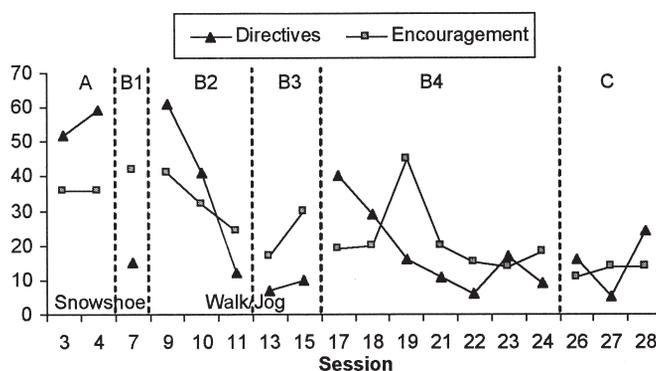


FIGURE 5. Verbal cues, encouragement, and directives given by school staff members during selected sessions of the snowshoe/walk/jog program. Verbal data were collected during 18 sessions throughout the program; the session numbers correspond to the session during which the verbal data were collected.

number of directives is evident in Sessions 9, 10, and 17, which took place in a different area of the park because of conflicts with a local elementary school physical education class.

Discussion

This study demonstrated that an instructional strategy that included self-monitoring, verbal cuing, and edible reinforcers was associated with increased sustained participation in a snowshoe/walk/jog program. Participants in the present study engaged in 30 min of physical activity twice per week, at an individually determined pace. Researchers have well docu-

mented that physical inactivity of adults with intellectual disabilities results in an increase in associated health risks (Draheim et al., 2002). Stanish (2004) found that walking is an activity in which adults with intellectual disabilities readily engage. Walk/run activities require little equipment and can be carried out in local parks. Also, because children with autism often have poorer motor skills than children without disabilities (Berkeley et al., 2001), programs that do not require high skill and can incorporate individuals of different skill levels are beneficial in educational settings. For instance, Robert was not able to jog continuously, but his two peers jogged a majority of the 30 min toward the end of the program, and all three were able to attend the same exercise program.

Individuals with autism often lack the motivation to exercise for sustained periods, which is necessary to reap health benefits associated with physical activity. Continuous moderate exercise for 30 min is beneficial to one's cardiovascular fitness, an important health factor (U.S. Department of Health and Human Services, 1996). Intensity of exercise, determined by distance covered in the 30-min time period, increased during the program and came close to meeting the U.S. Surgeon General's suggestion of moderate or brisk walking at a minimum rate of 4.8 km/hr (U.S. Department of Health and Human Services, 1999). Toward the end of the program, Tom and Mike completed 2.1 km and 2.3 km in 30 min, a walking rate of 4.2 km/hr and 4.6 km/hr, respectively. In addition, the activity was carried out over a 6-month period, while the edible reinforcers and verbal cuing provided by adults decreased. Future research should explore physical fitness and health-related changes that may accompany sustained physical activity.

We created the self-monitoring board to enable participants to record the number of circuits completed during each exercise session and taught them how to use it during the exercise program. Self-monitoring has been identified as an important skill and may be considered a component of pivotal behavior (Koegel, Koegel, & Carter, 1999). Purportedly, pivotal behaviors generalize across settings, increase independence, and decrease problem behavior. The participants did become increasingly independent as the activity progressed through the school year and were able to generalize the activity in two different settings: indoors and an alternative circuit in the park when the soccer field was in use by a local elementary school. The students understood the concept of recording each completed circuit, which was marked by the flags, regardless of the location.

The self-monitoring board acted as a record-keeping device during the physical activity in a manner similar to devices commonly used for token economy systems. However, we did not exchange the smiley faces for reinforcers; instead, we provided the reinforcers upon the completion of a predetermined distance. For example, in Condition B1, participants placed a smiley face on the board and received an edible for each completed circuit. Although the smiley face continued to be placed on the board for each completed circuit, we faded use of the edibles until none were given. The smiley faces thus were not exchanged for backup reinforcers, as in a token economy system, but were used for the purpose of self-recording only. An interesting topic for future research would be the role of the self-monitoring board in motivating continued physical exercise. The three youth in this study were motivated to engage in physical exercise, but their reasons are unknown. Initially, they may have been motivated to complete each section of the circuit to gain an edible reinforcer; however, as the edibles were faded, the behavior continued and the number of circuits completed increased. The adults' presence and use of verbal cuing may have been sufficient to perpetuate the activity. It is also not clear if increases in the number of smiley faces were

motivational or if the distance walked/jogged would have increased within the time allotted even without the placement of smiley faces for completed circuits. Use of a changing conditions design without alternating conditions does not allow the determination of functional relationships unless additional comparisons are incorporated. Future investigation using a research design would provide more information on the efficacy of each intervention.

The distance walked/jogged was not affected when we removed edible reinforcers during the final baseline sessions; actual distance remained the same as, or exceeded, that for the prior four sessions. One contributing factor may be that self-monitoring led to some degree of internal motivation. Deci and Ryan (2000) described an external-to-internal motivation continuum on which individuals can move. People may initially participate in activities in response to external motivators, but in time, internal motivators may replace the primary external motivators. Internal motivation is preferred to complete reliance on external motivators; thus, developing some degree of intrinsic motivation is a positive step toward increasing sustained participation in physical activity. The current data are consistent with the idea that participants moved toward more intrinsic motivation as the program progressed.

Traditional external control—edible reinforcers and verbal cuing—decreased during the 6-month program. Edible reinforcers decreased on a predetermined fashion, whereas the verbal cuing decreased naturally. We did not give the school staff members any directives regarding decreasing verbal interactions with participants, although we did encourage participant independence. As noted, several data points, one verbal encouragement (Session 11; Figure 5) and three verbal directives (Sessions 9, 10, and 17; see Figure 5), were above the average value for that time period. The rise in verbal encouragement occurred during Session 11 because Tom and Mike began to jog, which caused much excitement among both students and staff. Although jogging continued for the remainder of the program, verbal encouragement returned to prior levels in the next session. The peak values in verbal directives occurred in three sessions held in alternative areas of the park on days when a local elementary school used the soccer field. Although the participants agreeably performed the activity in an alternative area, more directives were required. Even though the number of verbal directives increased, it did decline from Session 9 to Session 10 and was still lower in Session 17, indicating the ease of generalizing this activity to different locations. This is consistent with Koegel et al.'s (1999, 2001) definition of *pivotal behaviors*: behaviors that generalize to different activities and settings. Use of the self-monitoring device and verbal cuing remained constant throughout the program and contributed to participation in sustained physical activity for these three young men with autism.

In addition to self-monitoring, each participant received regular attention and encouragement, which may have been responsible for some increase in participation and is consistent with results from previous research (Lombard et al., 1995;

Weber & Wernheim, 1989). One limitation of our study thus was the inability to ascertain which variable, or variables, was the prime mediator of performance. Collectively, self-monitoring, edible reinforcers, verbal cuing, extra attention, or even enhanced physical fitness itself may have contributed to the increased distance walked/jogged during the 30-min sessions. Yet, as physical activity increased throughout the program, verbal cuing and edible reinforcement decreased. Self-monitoring, which was constant throughout the program, was, we believe, an effective component of the exercise program. The self-monitoring intervention is easy to design, portable, and simple to use, making it a practical intervention for teachers and physical educators. It would be premature to conclude that self-monitoring was the sole or primary component in the program, however. Use of a changing conditions design and of an intervention package make it impossible to demonstrate a functional relationship among any of the individual components or the combination package. Future research should be carried out using alternative designs, such as a changing conditions design with replication, so that functional relationships may be demonstrated (Alberto & Troutman, 2006).

A second limitation of this study is that the baseline measurements, Conditions A and C, are not directly comparable. The first baseline was recorded during snowshoeing, whereas the final baseline was walking/jogging. Snowshoeing is a slower activity that requires more effort than walking and jogging, so it is natural that less distance is covered in a 30-min session. More snowshoeing sessions had been planned, twice a week from January through March, or as long as the snow lasted. We estimated this would be approximately 14 to 18 sessions. Unfortunately, excessively cold weather and ice forced the cancellation of the program for 8 sessions interspersed throughout the winter months; therefore, fewer snowshoeing sessions were completed than expected. When it became clear that only 9 snowshoe sessions were possible, we believed we had only two options: (a) return to a baseline condition in the walking/jogging program and restart the edible reinforcement protocol or (b) continue decreasing the edible reinforcers and forego a baseline condition in the walking program. We chose the second option because the effect of the self-monitoring and verbal cuing package was the focus of the study and we reasoned that decreasing external reinforcers as quickly as possible was a priority. Therefore, the walking program continued from the snowshoeing program, following the declining external reinforcement protocol. This decision did prevent us from establishing a stable walking baseline against which to compare the effect of the intervention during the walking/jogging program.

Despite the limitations, we have shown that as traditional edible reinforcers were eliminated and verbal cuing declined, distanced snowshoed, walked, and jogged increased. Use of the self-monitoring device remained constant throughout the program and may have contributed to participation in sustained physical activity for Tom, Mike, and Robert. In addition,

this simple, inexpensive strategy can be easily used in physical activity settings by parents, teachers, and physical activity specialists to encourage sustained participation. Future research must be conducted to verify that self-monitoring is an effective instructional strategy for increasing sustained participation in physical activity by individuals with autism.

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