Cycling for Students With ASD: 
Self-Regulation Promotes Sustained Physical Activity

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Individuals with autism often lack motivation to engage in sustained physical activity. Three adolescents with severe autism participated in a 16-week program and each regularly completed 30 min of cycling at the end of program. This study investigated the effect of a self-regulation instructional strategy on sustained cycling, which included self-monitoring, goal setting, and self-reinforcement. Of particular interest was the development of self-efficacy during the physical activity as a mediator of goal setting. A multiple baseline changing criterion design established the effectiveness of the intervention. The results suggest that self-regulation interventions can promote sustained participation in physical activity for adolescents with severe autism.

There is much to learn about promoting physically active lifestyles for people with or without disabilities. Physical activity may be particularly beneficial for people with autism spectrum disorders (ASD), as recent research has shown positive effects of sustained physical activity on both reduction of BMI (Pitetti, Rendoff, Grover, & Beets, 2007) and disruptive and stereotypic behaviors (Prupas & Reid, 2001; Todd & Reid, 2006); however, individuals with severe ASD often lack motivation to sustain regular physical activity. Interventions that incorporate self-determined behaviors may be one way of promoting regular participation. An ecological perspective of self-determination guided the intervention in the current study (Abery, Rudred, Arndt, Schauben, & Eggebeen, 1995; Aber & Stancliffe, 2003).

Self-determination refers to acting as the causal agent in one’s life (Wehmeyer, 1998). Wehmeyer and colleagues have studied self-determination of individuals with intellectual disabilities for many years (Wehmeyer, 1998, 2005; Wehmeyer, Aber, Mithaug, & Stancliffe, 2003; Wehmeyer & Metzler, 1995). Self-determined
behavior refers to actions that develop four essential characteristics: autonomy, self-regulation, psychological empowerment, and self-realization (Wehmeyer, Yeager, Bolding, Agran, & Hughes, 2003). The theory posits that self-determination emerges as children and adolescents learn skills and develop attitudes that enable them to act on their own accord. The Tripartite Ecological Model of Self-Determination breaks down the three areas of personal capacities associated with self-determination: skills, attitudes, and knowledge into component elements (Abery & Stancliffe, 2003). Eight skill areas are identified as important to possessing the skills necessary to act in a self-determined manner: goal setting, decision making, self-regulation, problem solving, personal advocacy, communication capacities, social skills, and independent living abilities. The personal capacity of attitudes, or one’s belief system, is shaped by a person’s locus of control orientation and attributions of success and failure, self-efficacy, self-esteem, feeling valued by others, and a positive outlook on life. Knowledge supportive of self-determination includes knowing about resources, laws, rights, and options available, as well as self-knowledge. As each area develops, other areas are positively influenced. Therefore, it is important that people possess skills and attitudes to act in a self-determined manner; for instance, one requires a certain degree of self-efficacy to set a realistic goal.

Unfortunately, individuals with severe disabilities may lack the knowledge, attitudes, and skills to act in a self-determined manner even if given opportunities. Wehmeyer (2005) cogently argued that simply providing opportunities to be self-determining will not be beneficial until individuals possess the required knowledge and attitudes. In a physical activity study by Todd and Reid (2004), an intervention based on two self-determination skills, self-monitoring and goal setting, was introduced to students with severe ASD. They learned to self-monitor but goal setting was only accurate 53% of the time. Perhaps the participants did not possess required abilities, such as self-efficacy, to engage in goal setting. The present study focused on specifically teaching goal-setting skills during a cycling program.

The intervention drew on skills within the self-regulation component of self-determination, which have been effective for students with disabilities on academic and vocational tasks (Agran, Blanchard, Wehmeyer, & Hughes, 2002; McDougall & Brady, 1998; Wehmeyer, Yeager et al., 2003). Self-regulation strategies aim to teach skills that will increase autonomy, such as goal setting and self-monitoring. It is common for two to four components to be combined. For example, one study found success using a multicomponent intervention that included self-monitoring, self-evaluation, and self-reinforcement (Wehmeyer, Yeager et al., 2003). In fact, Bandura (1997) stated that to achieve the best results, several elements of self-regulation should be taught together rather than one skill at a time. The intervention in this study used a multicomponent intervention, consisting of goal setting, self-monitoring, and self-reinforcement.

Goal setting has received considerable attention as a strategy to motivate people in work and school environments (Columbus & Mithaug, 2003; Locke & Latham, 2002). Bandura (1997) asserts that challenging goals, along with strong self-assurance in one’s ability to fulfill them, serves as a strong motivator in the physical domain. In addition, meeting subgoals builds a sense of efficacy and fosters interest in the activity. Goals that are specific, realistic, and proximal are most effective. The influence of goal setting is bidirectional; when goals are met, efficacy can increase and efficacy beliefs influence the level at which a goal is set. On the
other hand, if a goal is not met, efficacy beliefs may decrease and the person will set an easier goal at the next opportunity. Individuals with severe autism typically have limited ability to set personal goals, in part because they may not understand their own capability. A systematic approach to goal setting was employed in this study. Before goal setting for cycling distance, participants were given guided opportunities to understand their cycling capabilities; this provided a basis on which to set goals. After the participants developed a sense of physical efficacy, distance goals were introduced.

Self-monitoring, in conjunction with goal setting, is critical to physical self-efficacy. Self-monitoring is the process of systematically gathering information about a target behavior without use of external controls (Ganz & Sigafos, 2005; Martin & Anshel, 1995). During self-monitoring, people detect the occurrence of an event and record it (Ganz & Sigafos; Wehmeyer, 2005). Self-monitoring helps them discern when their target goal has been reached; this, in turn, allows individuals to evaluate if reinforcement is in order. Self-reinforcement refers to immediate reinforcement following the occurrence of a desired behavior; two activities are involved: discrimination of goal achievement and delivery of the reinforcer (Agran & Wehmeyer, 2006). Self-reinforcement shifts control of the consequences in learning from the teacher to the student, thus providing considerable potency to self-regulation (Agran & Wehmeyer).

Interventions that increase self-regulation skills and provide progressive mastery experiences in movement should strengthen individuals’ beliefs of their physical capabilities (Bandura, 1997). As perceived efficacy strengthens, there is greater interest and enjoyment in physical activity (McAuley, Courneya, & Lettunich, 1991), which increases the likelihood that students will participate in the activity (Bandura, 1997; Bandura, Caprara, Barbaranelli, Gerbino, & Pastorelli, 2003). Therefore, helping students develop a sense of efficacy during physical activity may play an important role in stimulating regular, sustained engagement.

In this study, we investigated the impact of an intervention program that included goal setting, self-monitoring, and self-reinforcement on sustained physical activity of three adolescents with severe autism. In addition, self-efficacy was monitored, as this ability is crucial to developing goal setting. A multiple-baseline changing criterion design was used to evaluate if self-regulation promoted cycling behavior. Cycling, a typical physical activity for adolescents in North America, was chosen as the physical activity. Cycling can be adapted to meet varying skills levels, may generalize to community or family activities, and can be done almost anywhere, thus encouraging an active lifestyle.

### Method

#### Participants

Three students, one female and two male, aged 15–17 years, participated. Lisa, Mark, and Daniel attended a school for students with moderate to profound disabilities and had a primary diagnosis of autism. They were nonverbal and communicated using pictograms. The students were recommended for the study by the physical educator and classroom teacher because they possessed the physical skills required to cycle and the cognitive skills to understand the concept of more or less,
for example, that five is greater than two. This skill was necessary for setting goals in regard to the number of circuits to cycle during one session. Parental permission was obtained for the students to partake in physical activity and to collect data.

Lisa, Mark, and Daniel were categorized as having autism according to guidelines of the Ministère de l’Éducation de Québec’s Guide de la Déclaration d’Effet Scolaire des Jeunes en Formation Générale (DCS; Ministère de l’Éducation de Québec, 1996). This categorization follows a diagnosis of autism (DSM IV-R 299.00) by a multidisciplinary team (American Psychological Association, 2000). Basic demographic information was supplied by the school; however, socio-economic status, extracurricular activities or therapies, and medication records were not available (Table 1).

They attended a class for students with severe disabilities ages 13–21 years. The class was based on the Floortime approach (Greenspan & Wieder, 1998). Pictograms were used to indicate the daily schedule for each student and to allow students to indicate specific needs. The classroom teacher and teaching assistants gave students edible reinforcers regularly throughout the day as motivation to continue working on a task and to indicate a job well done.

**Activity**

The cycling program occurred three days per week from March to June, in addition to the regular physical education program. Three cycles were available; the participants selected the adapted bicycle or adult tricycle they preferred to ride. Lisa rode a bicycle that was lower to the ground than a standard bicycle and had two stabilizing wheels, while Mark and Daniel rode adult tricycles. The adult tricycles were fitted with seats, back rests, seat belts, and Velcro straps on the pedals which fitted over shoes. All participants wore bicycle helmets. Each session provided the opportunity to cycle for 30 min.

The cycling program included three self-regulatory skills: self-monitoring, goal setting, and self-reinforcement. Self-monitoring was part of the program from start

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (yrs)</th>
<th>Diagnosis</th>
<th>Race</th>
<th>Education</th>
<th>Related disabilities</th>
<th>Residential information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lisa</td>
<td>16</td>
<td>Autism Intellectual disability-severe range</td>
<td>Caucasian</td>
<td>Special school</td>
<td>None reported</td>
<td>Group home</td>
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<tr>
<td>Mark</td>
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<td>Autism Intellectual disability-severe range</td>
<td>Caucasian</td>
<td>Special school</td>
<td>Scoliosis</td>
<td>Group home</td>
</tr>
<tr>
<td>Daniel</td>
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<td>Autism Intellectual disability-severe range</td>
<td>African</td>
<td>Special school</td>
<td>None reported</td>
<td>Home</td>
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to finish. Participants were introduced to goal setting systematically, first setting intensity goals (phase B1), followed by distance goals (phase B2). Edible reinforcers were given to the participants during the first 12 sessions, regardless of the phase they were in, after which they took their own edibles in a self-reinforcing manner.

**Activity Circuit.** An outdoor cycling course was created on the asphalt surface of a fenced school yard with orange pylons 35 m apart. Participants cycled around the circuit, keeping the pylons on the left. A self-monitoring/goal-setting board was placed on the fence directly behind the first pylon. One circuit measured 75 m, 35 m each direction, and 2.5 m for turning. The activity took place inside the school on rainy days. The circuit was in a hallway connected to the gymnasium. The self-monitoring/goal-setting board was hung in the gymnasium. One circuit measured 77 m, quite comparable to the outdoor circuit.

**Self-Monitoring Board.** A self-monitoring board of laminated poster board, 76.2 × 101.6 cm, was divided into vertical columns, with the name of each participant at the top of his or her respective column. Each name was written in a different color that matched the color of the markers placed on the board. Small happy face markers indicating the participants’ goal were placed on the left side of each person’s column. The right side was used for self-monitoring, with large, 7.6 cm diameter, happy face markers (Figure 1).

![Figure 1 — Self-monitoring board.](image-url)
Goal-Setting Card. A laminated card was prepared for each participant before the start of the session and had two pictograms. During phase B1, intensity pictograms were placed on the card. The high intensity, or fast, pictogram was a stick figure running; the low intensity, or slow, a stick figure walking. While the program was cycling, the students understood the walk and run pictograms better than a slow and fast tricycle. Goal setting changed to distance goals during phase B2; these number pictograms had a printed number with corresponding small markers. If a participant selected six, the square would have the number 6 and six small happy face markers on it (Figure 2).

Self-Efficacy Questions. Self-efficacy was assessed by asking two simple questions and providing a choice of pictograms to communicate an answer. The participants were asked how confident they were that they could reach their chosen goal. Two pictograms were printed in small squares on a card: one agreeable cartoon figure depicted an affirmative answer such as “I can” or “I’m sure” and one figure looked unsure and questioning, representing the answer “I don’t know” or “I am not sure I can.” These figures were directly below the pictogram depicting the goal chosen by the student for the particular session (Figure 2). The students pointed to the figure that represented how they felt with regard to meeting the goal set.

Figure 2 — Goal-setting card and self-efficacy question.
Design

A multiple baseline changing criterion design was used. Single subject designs are common in research with individuals who have severe developmental disabilities and in research on self-determination skills. Multiple baselines help demonstrate experimental control, in this case, the functional relationship between the use of self-regulation skills and changes in cycling distance (Alberto & Troutman, 2006). Criteria for baseline stability was defined as variability less than 50%, which has been recommended for classroom research (Alberto & Troutman). In addition, staggered baselines inherent in a multiple baseline design gave the primary researcher a chance to spend time on instruction with each participant when introducing goal-setting.

The changing criterion dimension of the design permitted each student to progress at his or her own pace and ensured that certain competencies were met before moving ahead to a more complicated or autonomous part of the program. This enabled each participant to build on existing skills and experience success during the program.

Procedure

Activity. The primary researcher met the participants at the classroom and walked with them to the cycling circuit. The program began mid-March and continued until early June, a 12-week period. Thirty-one sessions were completed; 12 sessions were held indoors and 19 outside. The first nine sessions were inside because the school yard was not dry and the weather was cool. Three sessions during April and May were held inside because of rain. Two sessions were cancelled due to holidays, two for teacher study days, and one for a class field trip. In addition, Mark missed six sessions (4, 15, 18, 22, 26, and 28), due to scheduled hydrotherapy appointments, and Daniel was ill and could not participate for sessions 12, 16, 17, and 22. Lisa and Daniel opted for alternative classroom activities on four occasions.

One teaching assistant from the students’ classroom accompanied them during each session. Upon arriving at the cycling circuit, the participants chose the bicycle or trike they wanted to ride. Participants were assisted with the lap belts and helmet straps. Once the students were securely seated, they began the activity.

Following classroom protocol, edible reinforcers were given to the participants throughout the program. The edibles, potato sticks and pretzels, were laid out on a tray at the beginning of each session, pretzels on one side, potato sticks on the other, and placed at the start/finish point. Edibles were offered to the participants for the first 12 sessions. Self-reinforcement began on session 13; the reinforcers were available at the start/finish point but not offered by the teaching assistant or researcher. The specific reinforcers were recommended by the participants’ teacher. Each small stick pretzel was broken into two pieces, one piece was one reinforcer; one potato stick was also one reinforcer.

The primary researcher was always in attendance and ensured the intervention was carried out in a consistent manner. Goals set, distance cycled, time to complete one circuit, and the number of reinforcers taken were recorded for each session. A photograph of the self-monitoring board was taken immediately following each
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session to provide a record of each participant’s goal and distance completed. Each time a participant took an edible, the primary researcher marked on a tally sheet to keep track of the number of reinforcers per participant. Forty edible reinforcers were set out at the beginning of each session; the number of remaining edibles were noted and compared with the recorded number of edibles taken to ensure accuracy. Field notes were kept and updated upon the completion of each session by the primary researcher.

The intervention consisted of three phases: (a) phase A, baseline; (b) phase B, an instruction phase divided into two parts: phase B1, intensity goal setting and phase B2, distance goal setting; and (c) phase C, maintenance.

**Phase A: Baseline.** Students completed a baseline during which they self-monitored the distance cycled, and edible reinforcers were provided upon the completion of each circuit. Participants self-monitored the distance cycled by placing a marker on the self-monitoring board upon the completion of each circuit. Self-monitoring and reinforcement were part of the intervention throughout the program.

**Phase B1: Instruction for Intensity Goal Setting.** Participants set intensity goals, and goal setting accuracy was assessed; self-monitoring continued during this phase, and reinforcement changed to self-reinforcement on the 13th session. Goal-setting instruction began with participants being asked if they wanted to work hard, go faster that lap, or take it a bit easier, which meant to cycle slower during the next circuit. After they chose an intensity goal, the pictogram representing the level was placed on the left side of the student’s column on the self-monitoring board.

Circuits were timed on three occasions a session. When a circuit was to be timed, the primary researcher asked each student how confident they were that they could meet their intensity goal by using the self-efficacy questionnaire. The chosen intensity pictogram was placed on the top of the pictures of the two self-efficacy choices, and participants were asked to indicate how confident they were that they could complete that circuit’s goal. Students were informed that the circuit would be timed; no additional prompts were given while students were cycling. Feedback at the end of these circuits included statements such as “You went fast—you knew you could do it!” if a student chose the fast goal, but, in fact, went slowly, feedback such as “You went the same as this [show slow pictogram], you did not go fast that time.” The efficacy questions were posed to determine if the participants understood their ability to perform the task and answers were compared with goal setting accuracy.

Intensity goals, circuit times, and number of reinforcers taken were recorded. **Phase B1** was considered complete when intensity goals corresponded to times completed for three of four consecutive sessions that had faster times for the high intensity goal and slower times for the low intensity goal. An important part of developing accurate goal setting while cycling is to be aware if one is going fast or slow; in that way, work output can be adjusted to meet distance goals.

**Phase B2: Instruction for Distance Goal Setting.** During this phase, students were given two distance choices, the average number of circuits from the previous two sessions or that number plus one. In addition to the pictogram cards, the numbers were verbalized as they were shown to the student. Students chose their goal by
pointing to a card. Once the goal was identified, the corresponding number of small happy face markers was placed on the left side of the column on the self-monitoring board under that student’s name. The students placed a large happy face marker on the right side of the column, directly across from a small marker, as each circuit was completed. This enabled the participants to monitor their progress toward the goal. Several times during the session, students were reminded of the goal they had set; their attention was drawn to the self-monitoring board and the difference between the circuits completed and their goal. For example, it might be pointed out to Lisa, “Look you have finished 5 laps, and you only need 3 more to meet your goal.”

Distance goal set, number of circuits completed, and the number of edible reinforcers taken were recorded. During the first half of each session, students were asked if they felt they could complete their distance goal. Each participant’s distance goal was placed above the two answers on the self-efficacy card (Figure 2). It was reasoned that as students became more aware of their own abilities, they would become more accurate when setting goals. They began phase C, when they set goals accurately, reaching or exceeding their goal for three of four consecutive sessions. Due to the limited choice of goals, if a goal was exceeded, it was recorded as met, in the spirit that the student had worked as hard as he or she predicted.

Phase C: Maintenance. Participants set distance goals, self-monitored, and took edible reinforcers during this phase, but without instruction on self-monitoring or verbal feedback on progress toward their goal. Participants were able to self-monitor distance goals, as opposed to intensity goals, when they had to rely on someone to time circuits; therefore, distance goals were the only type of goals set in this phase. Social interactions and verbal encouragement such as “Good job today” and “Keep pedaling” were maintained. Each participant’s self-efficacy was assessed twice a week. Feedback was provided visually through the self-monitoring board.

Results

Distance

The number of circuits completed per session was visually analyzed. Lisa and Daniel increased circuits cycled over the course of the program. Lisa completed an average of 4 circuits during baseline, 7.5 during B1 and just over 10 circuits per session during phase B2 and maintenance (Figure 3). Lisa completed 13 circuits on two occasions, therefore cycling almost one kilometer in 30 min during these sessions. Daniel averaged 2.8 circuits during baseline, 6 during phase B1, and had a mean of 9 circuits for the last 8 sessions of the program, phase B2 (Figure 3). He did not reach maintenance because he did not meet the criteria to change to phase C until the last session.

Mark did not increase the distance cycled per session over the course of the 12-week program (Figure 3). The number of circuits Mark completed each session was quite variable, ranging from 1 to 6, and this was not dependent on the phase of the program. Mark did join the group on a regular basis and remained in the gymnasium or outside for the 30-min session, but many times was content to sit on his tricycle and observe his peers.
Figure 3 — Distance cycled by Mark, Daniel, and Lisa over 31 sessions.
Goal Setting

**Intensity Goals.** Figure 4 shows the average time for circuits completed under the low intensity condition was longer than for circuits chosen as high intensity. The time difference was 44 s for Lisa, 50 s for Daniel, and 39 s for Mark. These results suggest that the participants understood the difference between setting a goal of slow or fast. The criterion to move to phase B2 was 75% accuracy in meeting the goals set for each timed circuit; Lisa met the criteria in 5 sessions, Mark in 8 sessions, while Daniel remained in this phase for 11 sessions.

**Distance Goals.** As in phase B1, the criterion to move to phase C, maintenance, was 75% accuracy in meeting or exceeding one’s goal. Lisa completed seven sessions in this phase, Mark ten, and Daniel eight sessions. Daniel met the criterion to move to phase C during the final four sessions of the study; unfortunately, school was finished, preventing Daniel from participating in phase C. Exceeding one’s goal occurred 17 times during the program; this was attributed to the limitations of having only 2 distance choices, so the criteria for having met one’s goal was to cycle the number of circuits chosen or more.

**Self-Efficacy.** During phase B1, time per circuit was compared with the intensity goal chosen and the participants’ perceived ability to achieve the goal, that is, their self-efficacy for that particular circuit. During the 5 sessions of phase B1, Lisa indicated that she knew when she was cycling at a slower pace and regularly pointed to “I can” when she cycled at the appropriate speed for the low intensity level. The high intensity condition was more difficult, but by the third session, she was accurate for that condition also. Daniel and Mark usually indicated “I can” to both fast and slow goals during the first half of phase B1, but this was only 50% accurate. Mark’s accuracy began to increase after four sessions. Daniel’s perceived ability to perform at the chosen level developed over several weeks. He completed

![Figure 4 — Average time per circuit during phase B1.](image-url)
seven sessions before accurately knowing if he would go fast or slow. All three of the participants had more difficulty under the faster condition.

Self-efficacy was also evaluated during phase B2, but the question was changed to reflect the number of circuits chosen as the goal. During the first six sessions of this phase, Mark was apt to chose the answer “I’m not sure” when asked about his perceived ability to meet the distance goal selected for the session; this accounted for 50–66% of the answers. Throughout the remaining sessions in phase B2 and C, Mark chose “I can” all but once. During session 26, he chose “I’m not sure” and actually did not achieve the number of circuits set as his goal.

Daniel and Lisa completed fewer sessions while setting distance goals than Mark did. Daniel chose the answer “I can” six times during the eight sessions of phase B2. The distance goal he set was not met twice during sessions 25 and 30. During the last four sessions, he met his actual goal one time and exceeded the goal by one circuit two times. Lisa grasped the concept of distance goal setting quite quickly, requiring only seven sessions in phase B2 to reach criteria; this enabled her to complete seven sessions in the maintenance phase. Although Lisa typically met the chosen goal, on the few sessions when less distance than initially predicted was cycled, she appeared aware and indicated such by choosing the “I’m not sure” pictogram when queried half-way during the 30-min time period.

Goal-setting accuracy increased with experience. As the participants set goals and received feedback during the cycling program, they became more accurate knowing what they were able to accomplish at a given moment. The number of times “I can” was selected and the goal met was higher during the second half of the program. This was demonstrated by Lisa and Mark’s average accuracy rate during the maintenance phase (78%), which is higher than the average in phase B of 55%.

**Edible Reinforcers.** The number of reinforcers taken by each participant during each session was compared with the number of circuits cycled. Edible reinforcers were given at a rate of one per circuit, at the completion of the circuit, during the first 12 sessions. Edibles were available at the start/finish point for self-reinforcement during sessions 13–31. Lisa and Daniel continued to average one edible per completed circuit throughout the program. On one occasion, Daniel took six pretzels during the course of two circuits, and Lisa took only four pretzels or potato sticks while completing eight circuits on two occasions. Mark appeared less interested in the pretzels and potato sticks and took one only 65% of the time.

**Discussion**

This study demonstrated that attention to attitudes required in self-determined behavior is beneficial when designing interventions to increase sustained physical activity for individuals with severe autism. The attitude and skills necessary to effectively engage in the self-regulation skills of self-monitoring, goal setting, and self-reinforcement were taught during the cycling program. Earlier studies have found that individuals with severe disabilities benefit from direct instruction for self-determination skills. While opportunities to engage in self-determination skills such as self-monitoring and choice-making are increasing for individuals with severe disabilities, more complicated skills such as goal setting are typically not used in programs (Wehmeyer, 2005), even though the benefits of goal-directed
behavior have been well documented. Goal setting may be difficult to use because attitudes and knowledge required to set goals have not been developed by individuals with severe disabilities. This study showed that with direct instruction, these can be developed. Two of the three students, Lisa and Daniel, increased their distance cycled during a 30-min session as a function of the self-regulation intervention.

At the beginning of the program, Lisa, Mark, and Daniel were not accurate in meeting the intensity goals (fast or slow) that they choose for a specific cycling circuit. With specific, informative feedback, the students were able to differentiate between cycling fast and cycling slowly, and timed circuits were up to 60 s faster when the fast goal was chosen. The participants developed accuracy at different rates: Lisa moved through phase B1 in 5 sessions, meeting her goal 3 out of 4 sessions quickly; in contrast, it took Daniel 11 sessions. Similarly, accuracy in distance goal setting was achieved by all participants, but at different rates. Lisa spent seven and Daniel eight sessions in phase B2, while Mark required ten sessions before meeting criteria. Direct instruction targeting self-efficacy appeared to be beneficial in teaching goal setting.

These findings support the ecological perspective of self-determination that guided this study. Abernethy and Stancliffe (2003) emphasized the importance of abilities and knowledge that enable one to act in a self-determined manner. An important construct when setting goals is the capacity to know what one can do in a given situation, or, in other words, self-efficacy. Self-efficacy is a developmental construct; through countless interactions with the environment, a sense of personal agency is formed. The development of self-efficacy can be promoted or inhibited by the environment. Environments in which caregivers are responsive to communicative behavior, and that are enriched with opportunities for efficacious actions and various mastery experiences, promote the development of self-efficacy (Bandura, 1997). The developmental path of self-efficacy is not known for individuals with severe disabilities but appears to be less advanced than their typically developing peers. Introducing the concept of self-efficacy in a progressive fashion with informative feedback was effective in helping the participants develop an understanding of what they could accomplish during the physical activity.

A previous study by Todd (2007) used a similar intervention for a walk/jog program, but with only distance goal setting. The distance walked/jogged by the participants did not increase over the four-month program and goal setting was not accurate. This led to the exploration of the readiness of adolescents with severe autism to participate in certain self-determination skills. The present study showed that teaching not only self-determination skills but the abilities and knowledge required to successfully employ the skills can be successful.

The self-regulation intervention used in this study consisted of three components: self-monitoring, goal setting, and self-reinforcement. In addition, self-evaluation is an element of self-reinforcement. The strategy was successful in engaging Lisa, Mark, and Daniel in a 30-min cycling program over a 16-week period. Although Mark’s cycling distance did not increase over the duration of the program, he did attend on a regular basis and there was an increase over the last seven sessions. For several weeks in the middle of the program, Mark was more interested in sitting on his tricycle and watching everyone else cycle; he then began actively participating again. It is possible that Mark’s knowledge of the activity increased by observing others. Therefore, we do not know the impact of the intervention on
distance cycled by Mark if the program had continued. This does support Todd’s (2007) previous findings that some individuals with ASD require many weeks to feel comfortable and engage fully in physical activities. Future studies should take this into consideration and increase the duration of physical activity programs. The different impact of the intervention on Mark, compared with Lisa and Daniel, also supports the notion of a person-by-treatment interaction; that is, a given program will not be equally effective for all individuals (Bouffard, 1993).

The overall effectiveness of the intervention increased sustained physical activity. We do not know which component of the intervention was the most important or if it was the interaction that created the results; however, it has been suggested that self-regulation is not made up of a single component but rather is a multipart concept. Bandura (1997) explained that a major strategy for developing the efficacy and motivational supports required for adopting regular physical exercise comes from knowledge of self-regulation. Effective strategies include instruction on self-monitoring, proximal goal setting leading to increasingly vigorous activities, and supportive feedback. The strategy in this study included self-monitoring, goal setting, and informative, supportive feedback. Self-reinforcement was also part of this study, as reinforcers were used extensively by the school, and the students were accustomed to receiving edibles throughout the school day. Separating the components of self-regulation may have a negative impact on the result of strategies designed to increase sustained physical activity.

Limitations and Future Research

Limitations to this study include a small number of participants who attended a school for individuals with severe disabilities. The intervention was multicomponent, as suggested for self-regulation interventions, thus we cannot attribute the outcome to any one component in the intervention but must regard the intervention strategy as a whole. Edible reinforcers were used as requested by the school; however, the impact of the edibles is not known. Future studies with participants not receiving edibles on a regular basis should consider alternative types of reinforcement. Finally, participants were not able to choose the type of physical activity; it is possible that different activities could be more or less motivating to each individual. The intent of this intervention was to increase sustained physical activity; therefore, any aerobic activity could be substituted.

Cycling is an aerobic activity common in North America and can provide substantial benefits. Exercise intensity was not evaluated during this study, but the increase in distance cycled in 30 min during the program was positive. The benefits of regular, sustained, moderate exercise has been well documented and it may be helpful to record exercise intensity in future studies. This information can help to create programs that challenge students to set goals that meet exercise recommendations.

Conclusion

This study supports the concept that physical activity interventions that teach and encourage self-determination behaviors can be effective in promoting sustained physical activity for students with severe ASD. Though distance cycled did not
increase for Mark, he enjoyed the activity, sometimes watched others participate, and was able to stay engaged for 30 min most of the time toward the end of the 16 weeks.

References


