

Effect of Indoor Wall Climbing on Self-Efficacy and Self-Perceptions of Children With Special Needs

Erin R. Mazzoni, P. Lynn Purves, and Julie Southward

Queen Alexandra Centre for Children's Health

Ryan E. Rhodes and Vivienne A. Temple

University of Victoria

The impact of a six-week indoor wall climbing on the perceptions of self for children with special needs aged 6–12 years was explored. Participants ($n = 46$) were randomly assigned to the intervention (girls, $n = 4$; boys, $n = 19$) and control groups (girls, $n = 5$; boys, $n = 18$). Belayers' and children's perceptions of efficacy were measured using specifically designed questionnaires and perceptions of competence and global self-worth were measured using Harter's (1985) Self-Perception Profile for Children for participants with an adaptive age of 8 years or higher. Children's self-efficacy and belayers' ratings of children's efficacy improved significantly, $t(21) = 3.9, p = .001, d = .84$ and $F(2, 44) = 30.03, p < .001$, respectively. The children's judgments of their athletic and social competence and global self-worth, however, did not change over time or differ from the wait-listed control group ($p > .05$). These results suggest that it is likely that many experiences that enhance self-efficacy may be needed to improve self-perceptions.

In the model proposed by Shavelson, Hubner, and Stanton (1976) and Sonstroem, Harlow, and Josephs (1994) and adapted by Fox (2000), self-esteem, the evaluation of one's overall self, is construed in terms of a hierarchical model, whereby specific behavioral self-efficacies influence general behavioral competencies. These competencies, in turn, are used to create judgments of one's physical self, which is a critical antecedent of self-esteem. Self-efficacy (Bandura, 1997), the confidence an individual has in his or her ability to carry out specific behaviors, is foundational to hierarchical models of self-esteem (Spence, McGannon, & Poon, 2005). Perceptions of self-efficacy toward a task influence whether an individual will attempt the behavior or avoid it and will have some bearing on the individual's effort toward, and persistence with, the behavior (Bandura, 1977). Thus, efficacy expectations can become self-fulfilling prophecies: "The stronger the perceived self-efficacy, the more active the efforts" (Bandura, 1977, p. 194).

Erin Mazzoni, P. Lynn Purves, and Julie Southward are with the Queen Alexandra Centre for Children's Health in Victoria, British Columbia. Vivienne A. Temple and Ryan E. Rhodes are with the University of Victoria School of Exercise Science, Physical and Health Education. E-mail: vtemple@uvic.ca.

These active efforts are more likely to lead to positive outcomes, which subsequently influence the individual's perception of her/his competence. This hierarchical organization of the physical self (see for example, Fox & Wilson, 2008) suggests that situation specific efficacy mediates perceptions of competence, which in turn mediates more global perceptions of self-esteem.

This micro to macro hierarchy is evident within the literature. Children with poor motor skills tend to have lower perceptions of their athletic competence than children with better motor skills (Cantell, Smyth, & Ahonen, 1994; Maeland & Trondheim, 1992; Piek, Dworcan, Barrett, & Coleman, 2000; Rose, Larkin, & Berger, 1997; van Rossum & Vermeer, 1990; Watson & Knott, 2006). Further, among a cohort with movement difficulties, those with poorer gross motor skills had lower perceived athletic ability (Piek et al., 2000). Such perceptions of physical competence are strong predictors of self-worth among children with motor coordination difficulties (Rose & Larkin, 2002; Piek et al., 2000). Rose and Larkin demonstrated that for children with poor motor skills, perceived competence accounted for 64% of the variance in global self worth. Similarly, a study of motor ability and self-perceptions among children and adolescents with developmental coordination disorder indicated that athletic competence was a significant predictor of self-worth among boys (Piek et al., 2000). Rose et al. (1997) also demonstrated that children with poor motor skills had lower global self-worth than did their well coordinated peers.

Indoor Wall Climbing

Indoor wall climbing is a popular contemporary sport that has shown considerable growth. Between 1998 and 2001 participation grew by 57% (Ewert, Attarian, Hollenhorst, Russell, & Voight, 2006). This growth reflects increased accessibility through the development of indoor climbing gyms and the introduction of walls into recreation centers, community centers, and schools (Stiehl & Ramsey, 2005). The increase in popularity also reflects the ease and safety of indoor wall climbing (Greenwald & Marchant, 1996) and personal success associated with the individualized nature of the experience (Gard, 2002; Mazzoni et al., 2006). Climbing affords participants opportunities to concentrate and focus; to develop problem solving skills, self-efficacy, self-esteem, and competence (Bourdin, Teasdale, & Nougier, 1998; Sarrazin, Roberts, Cury, Biddle, & Famouse, 2002); and has been shown to produce positive adaptations in aerobic fitness (Watts & Drobish, 1998) and increased muscle strength (Lirgg, Di Brezzo, & Gray, 2006).

Empirical evidence of the benefits of wall climbing for children with a disability is not plentiful; however, the available research suggests positive outcomes. Indoor wall climbing has been shown to enhance strength, mobility, self-esteem, and movement skills among children and youth with a disability. Heitkamp and colleagues (2005) reported improved muscle strength (cervical extensors, lumbar thoracic extensors and flexors, rotators, and right and left lateral flexors) and cervical mobility for 19 adolescents with scoliosis who participated in 12 weeks of indoor wall climbing twice per week for 1 1/2 hr per session. Indoor wall climbing has also been successfully used to improve mobility for students with cerebral palsy (Cheng, Resurreccion, Tzeng, & Diamond, 2004) and a conference poster

suggested that climbing may enhance self-esteem among students with developmental coordination disorder (Hsieh et al., 2004).

Because of the possible benefits and its motivational potential, indoor wall climbing has been included in rehabilitation therapy programs. Indoor wall climbing is used as physical therapy at the Brooke Army Medical Center Amputee Patient Care Program (Armed Forces Amputee Patient Care Program, 2007) and as a rehabilitation option in the Wounded Warrior Disabled Sports Project (Disabled Sports USA, 2005). Climbing has also been used as physical therapy with youth. The Recreation Department at Shriners Hospital for Children in Chicago has offered a wall climbing program for teenagers with amputations for several years. The recreational therapists and physical therapists who designed the program were aiming to help young people develop inner resources, self-esteem, and new skills. Johnson, Bland, and Rathsam (2001) suggested that the program encouraged young people to step outside their comfort zones, to problem solve, and to explore their mental and physical abilities.

The aim of this study was to examine the effect of an existing rehabilitation therapy service climbing program on perceptions of self for children with special needs. Specifically, we were interested in the impact of the program on children's efficacy toward climbing; their self-perceptions in the domains of athletic competence, social acceptance, and global self-worth; and belayers' perceptions of children's climbing efficacy. The assessment of self-esteem and task self-efficacy judgments followed the model proposed by Shavelson et al. (1976) and Sonstroem et al. (1994) and adapted by Fox (2000). Specifically, we hypothesized that successful climbing experiences would influence self-efficacy appraisals of basic tasks associated with climbing, which in turn may influence general feelings of athletic competence and potentially social and global self-worth.

Method

Participants

The sampling frame was children with physical, developmental, and or emotional/behavioral challenges receiving specialized health care services from a children's health center. The following inclusion criteria were applied: (a) children were receiving services from a physiotherapist and/or an occupational therapist at school, (b) children scored at or below the 15th percentile on the Movement Assessment Battery for Children, (c) children were between the ages of 6–12 years, and (d) children had not previously indoor wall climbed. Therefore, similar to studies such as Cantell et al. (1994), Piek et al. (2000), and Rose and Larkin (2002), all of the children recruited into this study had poor motor skills. In addition, the impetus for referral to the climbing program was the perception by school-based physiotherapists and occupational therapists that the child was experiencing difficulties in physical education.

The term *special needs* has been used in this manuscript to refer to this group of children as it is the term used by the Ministry of Education in British Columbia, Canada (Ministry of Education, 1995) to refer to students with a disability; plus each child recruited into this study has a disability as well as difficulty in motor

functioning. Of 64 children invited, 48 agreed to participate. University and Health Authority ethics approval was obtained, and participants and their parents provided assent and informed consent, respectively.

Recruited participants were randomly assigned to the intervention or wait-listed control groups. Baseline data were collected on each child's chronological age, adaptive age, body mass index, and disability. After the first week, two children withdrew from the study: one child could not manage the demands of the climbing environment and the other did not have transportation after the first session. The final sample was 46 children, 23 in the intervention group (girls, $n = 4$; boys, $n = 19$), and 23 in the control group (girls, $n = 5$; boys, $n = 18$). Table 1 shows participants' age, Body Mass Index (BMI), and Scales of Independent Behavior (SIB-R) scores, and Table 2 provides a frequency of specific disabilities within each group. A series of one-way ANOVAs revealed there were no significant differences between the intervention and wait-list groups for the following variables: age, $F(1, 44) = 1.579, p = 0.215$; BMI, $F(1, 41) = 0.467, p = 0.498$; overall adaptive behavior, $F(1, 42) = 0.421, p = 0.520$; or any of the SIB-R subscales ($p \geq .05$).

Instruments

Age and BMI. Chronological age was calculated as the age in years according to the birth date and the date of initial data collection of the Self-Perception Profile for Children (SPPC), SIB-R, and BMI. Body mass was measured using an electronic scale (Scale-Tronix Wheelchair Scale Model 6700; White Plains, NY) to the nearest 0.1kg and height was measured using a wall-mounted stadiometer (Stat 7X Ellard Instruments, Monroe, WA) to the nearest centimeter. Body mass index was calculated with the formula $BMI = kg/m^2$.

Movement Assessment Battery for Children (Movement ABC). The Movement ABC (Henderson & Sugden, 1992) provides an indication of impairments in

Table 1 Participant Demographics and Scores on the Scales of Independent Behavior (SIB-R)

	Intervention		Control		All	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Age	8.7	1.6	8.1	1.7	8.4	1.7
BMI	19.1	3.1	19.9	4.8	19.5	4.1
SIB-R						
Overall adaptive behavior	6-9	2-3	6-3	2-10	6-6	2-6
Motor skills	6-1	2-4	6-6	2-9	6-3	2-6
Social interaction and communication	7-2	3-4	6-7	3-7	7-1	3-6
Personal living skills	6-7	2-6	5-11	3-0	6-3	2-9
Community living skills	6-8	2-5	6-4	2-9	6-6	2-6

Note. SIB-R scores are expressed in Years-Months; 6-2 is equivalent to 6 years and 2 months.

Table 2 Frequency of Specific Disabilities Within Each Group

	Intervention	Control
Developmental coordination disorder	7	2
Autism spectrum disorder	2	10
Learning disability	2	4
Fine motor difficulty	3	2
Developmental delay	3	2
Sensory issues	3	0
Spina bifida	0	1
Angelman syndrome	1	0
Velo-cardiofasical syndrome	0	1
Down syndrome	1	0
Cerebral palsy (hemiplegia)	0	1
Behavioral issue	1	0

motor functioning in children. Performance is related to motor norms using age-dependent standardized scores measuring different aspects of motor ability: fine motor skills, ball skills, and static and dynamic balance. The test provides both a quantitative and qualitative analysis of the child's motor performance. The test has acceptable validity and reliability (Croce, Horvat, & McCarthy, 2001; Henderson & Sugden, 1992). The reliability and concurrent validity has been previously validated with children ages 5–12 (Croce et al., 2001). The final score obtained from the Movement ABC indicates the extent to which a child deviates from the level of his or her age peers. The 15th percentile was used as the criterion for inclusion into this study as this cut-off has the best sensitivity and specificity for detecting motor problems (Henderson & Sugden, 1992; Schoemaker, Smits-Engelsman, & Jongmans, 2003).

Scales of Independent Behavior. Adaptive age was assessed by asking parents to complete the Scales of Independent Behavior—Revised (SIB-R; Bruininks, Woodcock, Weatherman, & Hill, 1996). This rating scale evaluates functional independence and adaptive function. The measure has four subtests—Motor, Social/Communication, Personal Living Skills, and Community Living Skills. An overall adaptive behavior score is based on the average of the four subtests and provides an “age equivalence” based on adaptive function.

Self-Perception Questionnaire. Harter's (1985) Self-Perception Profile for Children (SPPC) is one of the measures most widely used by developmental social psychologists. Three subscales of the SPPC, athletic competence, social competence, and global self-worth were administered. Harter's SPPC has been used in many empirical studies with children with a disability as participants, including children with cerebral palsy (Schuengel et al., 2006), children with developmental coordination disorder (Piek et al., 2000), and children and adolescents with intellectual disability (Ninot, Bilard, Delignières, & Sokolowski, 2000; Shapiro & Dummer, 1998). As the SPPC was designed to assess domain specific and global self-worth of children aged eight or older (Harter, 1985), self-perceptions were

only assessed for children with a chronological age and an adaptive age of 8–0 or higher. Adaptive age was determined by the SIB-R. Ten children in the climbing group and eight children in the wait-listed control group met this criterion. Internal consistencies in the current study were comparable with those previously reported (Harter, 1985). At pretest and posttest, the alpha coefficients were the following: athletic competence, $\alpha = 0.72$ and $\alpha = 0.72$; social competence, $\alpha = 0.77$ and $\alpha = 0.84$; and global self-worth, $\alpha = 0.83$ and $\alpha = 0.80$, respectively.

Children's Questionnaire. A questionnaire focusing on the children's perceived ability to indoor wall climb was developed specifically for this project. The development of the questionnaire and the findings from the pilot study have been previously published (see Mazzoni et al., 2006). The self-efficacy questions were based on behaviors deemed important components of the climbing program and were developed using the inductive elicitation of mastery steps for climbing following Bandura's (1997) recommendations for developing a questionnaire. Thus the logical and content validity of the questionnaire was established by interviewing the principal physiotherapist and occupational therapist involved with previous climbing programs to identify key climbing and social behaviors for use in the scale. Behaviors deemed important components of the climbing program were identified by each therapist; the list from both therapists was combined and then examined by all authors for consensus. The internal consistency of the children's questionnaire was examined in the pilot study using Cronbach's alpha. An internal consistency score of .70 is regarded as a minimum acceptable value for scale reliabilities (Nunnally, 1978), and the scale demonstrated internal consistency of $\alpha = .91$. The questionnaire consists of 15 questions: 14 measure self-efficacy toward climbing (see below) and one question asked whether the children wished to continue to climb at the end of the program. The self-efficacy checklist was internally reliable at pretest and posttest ($\alpha = .80$ and $\alpha = .74$, respectively); all questions were answered on a 4-point scale: 1 = *disagree in a big way*, 2 = *disagree in a small way*, 3 = *agree in a small way*, and 4 = *agree in a big way*):

1. I can put things away (jacket off, water bottle) to get ready to do climbing.
2. I can go to put the harness on where the towels are down.
3. I can tell people I am ready by speaking or moving to beginner wall.
4. I can tie the knot on my climbing harness.
5. I can wait until my helper is ready before I begin.
6. I can start climbing with two hands and two feet on the wall.
7. I can find a way to climb up the wall without help from my belayer.
8. I can signal when I need to come down from climbing or when I need a break.
9. I can let go of the wall and hang in my harness.
10. I can stand-up when I am finished climbing.
11. I can untie the knot on my climbing harness when I am finished with climbing.
12. I can patiently wait my turn to climb.

13. I can introduce myself to new people at the climbing gym.
14. I have made 1 or 2 new friends at the climbing gym.

Belayer Checklist. The self-efficacy portion of the Children's Questionnaire was the basis of the checklist completed by each participant's belayer (who controls the rope system as the child climbs). Questions were reworded from the first to the third person. For example, "I can let go of the wall and hang in my harness" became "[Name] can let go of the wall and hang in his/her harness." Based on the findings of the pilot study (see Mazzoni et al., 2006), the scale of the belayer's questionnaire was changed from a 4-point scale to a 7-point scale to allow for additional discrimination. In addition to rating the children's climbing efficacy, belayers recorded the peak climbing height and the maximum route difficulty achieved on the day. The belayer checklist was found to be internally reliable in the present sample (Week 1, $\alpha = 0.92$; Week 3, $\alpha = 0.87$; and Week 6, $\alpha = 0.90$).

Procedures

Baseline assessments occurred at the Queen Alexandra Centre for Children's Health one week before the climbing program began. Participants completed the SPPC, height and weight were measured, and a parent completed the SIB-R. Before leaving the facility, parents selected a sealed envelope that randomly assigned the participant to the intervention group or the wait-list control group. The intervention group climbed in October and November and the wait-list control group climbed in January and February.

After the first and sixth climbing sessions, the intervention group completed the self-efficacy questionnaire. Both the intervention and the control group completed the second administration of the SPPC in the last week of the climbing program. Questions were read to the child if necessary. Each participant's belayer completed the efficacy checklist after the first, third, and sixth climbing session based on their observations of how the participant performed physically and socially.

The Program. The climbing program occurred after school once a week for six weeks for one hour at a commercial indoor climbing facility. Occupational therapists, physiotherapists, and volunteers belayed for the children. The child had the same belayer each day. Extra staff moved around the gym to help the child physically if they were having difficulty climbing, including coaching on the wall. The ratio of adults to children was 1:2 or 1:1, depending on the child's abilities and level of need.

The philosophy of the program was to provide each climber with an environment where she/he could be successful. The goals for each climber were individualized based on their first attempt at climbing. The key areas that were focused on during the climbing sessions were the following:

1. *Learning how to be safe in the environment.* The climbing gym was a public facility so there was an emphasis on learning and following the rules of the gym and to be aware of other climbers using the facility. The environment

was also very stimulating for some children (e.g., the colors of the walls, the height of the ceiling, music in the background, bouncy floors); therefore, for some children, the goal was to remain calm and on-task in the environment. Sensory breaks were incorporated into the program if required so that the individual child could be successful in the climbing gym.

2. *Learning climbing skills.* For every climb, the belayer described how to tie the rope to the harness and the children were encouraged to learn to do this independently by the end of the six weeks. The children were taught how to communicate with their belayer throughout the climbing process. This communication included making sure their belayer was ready before climbing, listening to verbal cues regarding the location of the next hand or foot hold (if necessary), and signaling to the belayer that they need a break or they want to come down. The children were taught how to start a climb, how to move their bodies on the wall, how to sit in their harness and take a break on the wall, how to descend safely, and how to take off their harness.
3. *Learning social skills.* The children were provided guidance about appropriate social interaction with their peers, such as looking at the person speaking and waiting for their turn on a particular route.

The routine for each climbing session was the following:

- As the child arrived at the gym he/she was expected to put her/his jacket and water bottle away independently and then go to a designated area to have his/her harness put on.
- Once the harness was on, the child and his/her belayer paired up to begin their climbing session. The routes at the gym are graded according to difficulty and children were encouraged to start on the beginner wall as their first climb of the day. The children mainly climbed on this wall, but as their skills and confidence developed they were free to choose other routes.

Individualization was a key program element. The climber to belayer ratio allowed the goals for each child to be specific to their needs. Some children needed physical assistance with hand-over-hand guidance and verbal cueing, some needed verbal guidance, and other children needed encouragement to persist with the task. The physical and occupational therapists involved with the program had various roles, including belaying children, assisting volunteers, assisting the children, and instructing on the wall.

Data Analysis

Descriptive statistics were computed for belayers' ratings of children's climbing efficacy, height climbed and route difficulty, children's self-efficacy toward climbing, and for children's self-perceptions of athletic and social competence, self-worth. A paired *t* test was conducted on climbing self-efficacy for the intervention group and an effect size was calculated using the following formula ($M2 - M1 / SD$; Cohen, 1992). Repeated measures analyses of variance were used to examine changes in athletic and social competence and global self worth and changes in belayer ratings of efficacy, height climbed, and route difficulty. Internal consistency scores were computed using Cronbach's alpha (Cronbach, 1951).

Results

Belayers' ratings have been presented in Table 3. Repeated-measures ANOVAs revealed a significant improvement in efficacy, $F(2, 44) = 30.03, p < .001$, partial eta squared = .577 and height climbed, $F(2, 46) = 9.387, p < .001$ partial eta squared = 0.290. Difficulty showed no effect across the three time points, $F(2, 46) = 1.480, p = 0.238$, partial eta squared = 0.060. The pattern of improvement in efficacy and height climbed was mirrored by the children's self-perceptions. A paired t test revealed a significant increase in self-efficacy toward climbing, $t(21) = 3.9, p = 0.001, d = 0.84$ from 42.6 ($SD = 6.5$) at pretest to 47.2 ($SD = 4.0$) at posttest. All of the children wished to continue climbing at the conclusion of the program with 90.9% agreeing *in a big way* and 9.1% agreeing *in a small way*.

Mean and standard deviations for perceived social and athletic competence and global self-worth for the intervention group and wait-listed control group whose chronological and adaptive ages were 8–0 and above have been presented in Table 4. There was no group effect for athletic competence, $F(1, 15) = 0.738, p = 0.404$, partial eta squared = 0.047; social competence, $F(1, 15) = 0.099, p = 0.757$, partial eta squared = 0.007; or global self-worth, $F(1, 15) = 0.132, p = 0.722$, partial eta squared = 0.009.

Discussion

Implications

The results partially support the proposition that successful climbing experiences positively influence children's self-perceptions. Consistent with a hierarchical model of self-esteem (Fox, 2000) and self-efficacy theory (Bandura, 1977), we hypothesized that self-efficacy appraisals of basic tasks associated with climbing would be the most amenable to change through mastery experiences. We further proposed that enhanced self-efficacy may, in turn, influence feelings of athletic and social competence and global self-worth. These perceptions of competence and worth tend to be more stable and therefore more difficult to change (Horn, 2004). Our findings indicate that the children showed enhanced efficacy expectations in relation to the specific physical and social tasks associated with climbing at the end of the program. These self-perceptions were also consistent with the belayers' assessments of the children's developing competencies. The children's self-appraisals, however, did not generalize to broader perceptions of personal

Table 3 Belayer Rating of Children's Climbing Efficacy, Difficulty of Best Climb, and Height of Best Climb

	Week 1		Week 3		Week 6	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Efficacy	70.74	17.97	86.26	15.18	92.61	12.41
Route difficulty	5.47	0.02	5.50	0.02	5.51	0.03
Height climbed	2.00	1.23	2.30	1.40	3.30	1.01

Table 4 Children's Self-Rating on Subscale Domains of the Self-Perception Profile for Children

	Intervention (<i>n</i> = 10)				Control (<i>n</i> = 8)			
	Pre		Post		Pre		Post	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Social competence	17.9	5.0	17.6	3.9	18.3	4.5	16.4	7.1
Athletic competence	13.5	4.1	14.2	3.9	15.4	4.7	16.3	4.4
General self-esteem	20.6	3.4	20.7	3.0	20.0	4.9	20.3	4.2

Note. Range of possible scores was 6–24.

competence. The children's judgments of their athletic and social competence and global self-esteem did not change over time or differ from the wait-listed control group.

The stability of perceived athletic competence and self-worth demonstrated in our study is consistent with the findings of the "adapted" group in Ninot and colleagues' (2000) study of the impact of integrated and segregated (i.e., adapted activities in a specialized context) delivery of sports programs for youth with intellectual disability. All groups in Ninot et al.'s study significantly improved their sport skills over an 8-month period, yet perceived athletic competence of youth in the segregated group did not change, whereas there was a significant decrease in the integrated group. This discrepancy was attributed to a more realistic appraisal of athletic competence in the integrated context due to social comparisons with peers without a disability. This decrease occurred despite increases in skill level. Our findings were consistent with those of the segregated group: Children's skills and self-efficacy toward climbing improved; however, there was no change in perceived athletic competence.

Our results are somewhat consistent with the findings of Hedrick (1985), who investigated the effect of eight tennis sessions on self-perceptions of children who used a wheelchair for mobility. Hedrick found the children significantly improved their tennis skill, their tennis-related self-efficacy, and their perceptions of physical competence. These changes were found in both integrated and segregated groups; however, this enhanced self-efficacy toward tennis was not associated with enhanced self-perceptions in other domains of competence. Unlike Hedrick's study, children in our study did not demonstrate significant improvements in perceived athletic competence. It is possible that the slightly longer duration of the Hedrick study facilitated generalization to athletic competence; or it is possible that children in Hedrick's study, who were recruited from an existing wheelchair athletic program, were more positively predisposed to change in the athletic domain.

Once self-efficacy is established, it tends to generalize to other situations; however, as Bandura (1977) notes, mastery and success do not necessarily lead to more generalized expectations of efficacy. When the individual's experience is not consistent with his or her established expectations of self-efficacy, little change may occur. In this instance it is not unreasonable to suggest that participants may

have lacked success with physical activity in the past. Indeed, the impetus to establish this particular climbing program was concern by school-based therapists that many children they delivered services to were not experiencing success in their elementary or middle school physical education classes (Mazzoni et al., 2006). In addition, all of the participants had motor difficulties. The Movement ABC scores of the participants were below the 15th percentile at recruitment and their SIB-R subscores for motor skill were, on average, two years less than their chronological age. Theory and research suggest that many successful experiences that enhance self-efficacy over a long period of time are needed to improve self-perceptions (Horn, 2004; Hutzler & Bar-Eli, 1993). As Horn states, "It may only be through repeated performance successes or mastery experiences across a wide variety of performance contexts and situations . . . that the individual's sense of self at the higher levels may be affected" (p. 107).

Our findings suggest that for this group of children with special needs, repeated successes may have been particularly necessary in the physical domain. Perceived athletic competence was quite low in this sample, whereas global self-worth was robust. Research has demonstrated that global self-worth can be protected from negative effects of low self-perceptions of competence by downplaying the importance of a specific domain (Ebbeck & Stuart, 1993; Shapiro, Moffett, Lieberman, & Dummer, 2008). It is argued that in a domain, the individual considers unimportant, lack of competence is less likely to negatively impact evaluations of self-worth. As Shapiro et al. point out, this is of particular concern because individuals may withdraw from participation to protect their self-worth, which in turn may impact their fitness, health, and overall quality of life.

Children's perceptions of competence also may not have followed concomitant changes in self-efficacy because the children perceived the situation to be unlike those where they typically experienced physical activity; Bandura (1977) calls this discrimination. Individuals who feel that the "safeguards" of the experience are not the same as a typical circumstance may discount the importance of the experience. We deliberately created a highly supportive environment where the belayer to climber ratio was 1:1 or 1:2, therapists were on hand in the gym and on the wall, the program was individualized for the needs of each child, and social comparisons were with other children with difficulty in motor functioning. This created conditions where every child could be successful. Participants may have perceived this to be unlike other physical activity contexts in which they need to operate (such as physical education) and therefore may not believe they could be successful in these other contexts.

Limitations

It is important to note that the current study is limited by use of a wait-listed control-group rather than a control group that participated in another activity and by the length of the intervention. In addition, a priori calculation of sample size was using G*Power (Erdfelder, Faul, & Buchner, 1998) based on effect sizes from the pilot study (Mazzoni et al., 2006) revealed that samples of between 32–62 children were needed with alpha set at .05 and power at .8, depending on the variable under consideration. Exclusion of children with a chronological or adaptive

age below eight years for the computation of athletic competence, social competence, and global self-worth meant that these analyses were somewhat underpowered. Notwithstanding this limitation, the effect sizes on these variables clearly indicate that the differences between the means were trivial (Cohen, 1988); that is, the six-week program was not a sufficient condition to promote change in global and domain-specific self-perceptions. Although an effect for self-efficacy was demonstrated, a more sustained intervention may have provided better indication of whether these self-appraisals would generalize to broader perceptions of personal competence.

It should also be noted that the sample was heterogeneous in terms of disability, and the majority of children recruited into this study were boys. Although the participants had diverse special needs, all of the children were receiving therapy services and were experiencing difficulty in motor functioning. We confirmed that the groups did not differ significantly in adaptive age, chronological age, or BMI following the process of randomization. Therefore a unique contribution of the current study, which adds to the veracity of the findings, is that participants were recruited and randomly assigned from the same sample. The high prevalence of boys in the sample appears to be the result of their preference. This was a volunteer sample of participants and it seems that boys self-selected into this activity. It may be of interest to discover why girls were not as attracted to climbing and whether they would respond to the program in a similar way to the children who participated in this study.

Future Research

It was beyond the scope of this study to follow up on repeated mastery experiences or the differences between this context and typical contexts; however, both of these factors could be explored with additional research. At the end of the program, all of the participants expressed a desire to continue to climb. It would be useful to know whether additional climbing sessions or participation in other similarly supported activities would lead to generalization of efficacy expectations. In addition, we know that judgments of self-efficacy are situation specific (Horn, 2004). The participants in this study felt efficacious about the physical and social aspects of climbing in this highly supportive environment. A next step may be to gradually fade the level of support until this support reflects more typical environments the children may access. Including children without a disability in succeeding programs may also help to reduce the discrepancies between the therapy-based program and programs more reflective of community-based climbing. Gradually fading support and including children without a disability may also help with the sustainability of the program as well as the transition to inclusive community contexts. Ninot and colleagues (2000) point out that when children with a disability compare their abilities with others, they develop a more accurate reflection of their own capabilities. These accurate perceptions prepared them to participate in community-based activities and reduce the risk of disillusionment when leaving specialized environments.

Conclusions

In summary, the program developed by the therapists at the Queen Alexandra Centre for Children's Health allowed children to work at a level individualized to their needs and capabilities. In response, the children showed improved self-efficacy toward climbing and stable athletic and social self-perceptions. It is possible that additional sessions, additional programs aimed at developing self-efficacy, and alterations to the context that reflect more typical environments may help children generalize efficacy expectations; however, utilizing a specialized adapted program approach may be a necessary first step in building a foundation of positive self-efficacy appraisals.

Acknowledgments

Ryan E. Rhodes is supported by a scholar award from the Michael Smith Foundation for Health Research, a new investigator award from the Canadian Institutes of Health Research. This research was funded by the Queen Alexandra Foundation for Children and the Vancouver Island Health Authority Child, Youth and Family Health Program.

References

- Armed Forces Amputee Patient Care Program. (2007). Center for the Intrepid Amputee Patient Care Program. Available at Intrepid Fallen Heroes Fund Web site: http://www.fallenheroesfund.org/content/pdf/2007_01_29_FACTSHEET_Amputee_Care_Program_FINAL_406_6_1_9292.pdf Retrieved Jan 3, 2008.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191–215.
- Bandura, A. (1997). *Self-efficacy, the exercise of control*. New York: Freeman.
- Bourdin, C., Teasdale, N., & Nougier, V. (1998). Attentional demands and the organization of reaching movements in rock climbing. *Research Quarterly for Exercise and Sport*, 69, 406–410.
- Bruininks, R.H., Woodcock, R.W., Weatherman, R.F., & Hill, B.K. (1996). *Scales of Independent Behavior - Revised: Comprehensive manual*. Chicago, IL: Riverside Publishing.
- Cantell, M.H., Smyth, M.M., & Ahonen, T.P. (1994). Clumsiness in adolescence: Educational, motor, and social outcomes of motor delay detected at 5 years. *Adapted Physical Activity Quarterly*, 11, 115–129.
- Cheng, J., Resurreccion, D., Tzeng, B., & Diamond, M. (2004). Efficacy and safety of an indoor rock climbing program as a complimentary physical therapy and recreational activity for children with cerebral palsy. *American Journal of Physical Medicine & Rehabilitation*, 83, 243–244.
- Cohen, J. (1988). *Statistical power analysis for the behavioural sciences* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112, 155–159.
- Croce, R.V., Horvat, M., & McCarthy, E. (2001). Reliability and concurrent validity of the movement assessment battery for children. *Perceptual and Motor Skills*, 93, 275–280.

- Cronbach, L. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297–334.
- Disabled Sports U.S.A. (2005). Wounded warrior disabled sports project. Available at: <http://www.dsusa.org/programs-wwdsp-about.html>. Retrieved Jan 3, 2008.
- Ebbeck, V., & Stuart, M.E. (1993). Who determines what's important? Perceptions of competence and importance as predictors of self-esteem in youth football players. *Pediatric Exercise Science*, 5, 253–262.
- Erdfelder, E., Faul, F., & Buchner, A. (1998). *International MS-DOS version of G*Power (Version 2nd)*. Düsseldorf, Germany: Institute for Experimental Psychology.
- Ewert, A., Attarian, A., Hollenhorst, S., Russell, K., & Voight, A. (2006). Programs that work evolving adventure pursuits on public lands: Emerging challenges for management and public policy. *Journal of Park and Recreation Administration*, 24, 125–140.
- Fox, K.R. (2000). Self-esteem, self-perceptions, and exercise. *International Journal of Sport Psychology*, 31, 228–240.
- Fox, K.R., & Wilson, D.K. (2008). Self-perceptual systems and physical activity. In T.S. Horn (Ed.), *Advances in sport psychology* (3rd ed.). Champaign, IL: Human Kinetics.
- Gard, C. (2002). Rock climbing in PE? *Current Health*, 2, 17–19.
- Greenwald, J., & Marchant, V. (1996). Grabbing customers. *Time*, 148, 34.
- Harter, S. (1985). *Manual for the self-perception profile for children. Revision of the Perceived Competence Scale for Children*. Denver, CO: Unpublished manuscript, University of Denver.
- Hedrick, B.N. (1985). The effects of wheelchair tennis participation and mainstreaming upon the perceptions of competence of physically disabled persons. *Therapeutic Recreation Journal*, 19, 34–46.
- Heitkamp, H.C., Fichter, C., Thoma, S., Grau, S., Horstmann, T., & Niess, A. (2005). Lumbar muscle strength training by climbing for scoliosis patients. *Medicine and Science in Sports and Exercise*, 37, S363.
- Henderson, S.E., & Sugden, D.A. (1992). *Movement Assessment Battery for Children Manual*. London: The Psychological Corporation.
- Horn, T. (2004). Developmental perspectives on self-perceptions in children and adolescents. In M.R. Weiss (Ed.), *Developmental sport and exercise psychology: A lifespan perspective* (pp. 101–143). Morgantown, WV: Fitness Information Technology.
- Hsieh, H., Wu, S., Chung, M., Lin, K., Chen, F., Wang, S., et al. (2004). Evaluation of a group rock climbing program for children with developmental coordination disorder. *Medicine and Science in Sports and Exercise*, 36, S264.
- Hutzler, Y., & Bar-Eli, M. (1993). Psychological benefits of sports for disabled people: A review. *Scandinavian Journal of Medicine & Science in Sports*, 3, 217–228.
- Johnson, K.A., Bland, M.K., & Rathsam, S.M. (2001). 'Rec-reating' the healthcare paradigm. *Parks & Recreation*, 36, 58–67.
- Lirgg, C.D., Di Brezzo, R., & Gray, M. (2006). Effect of climbing wall use on the grip strength of fourth-grade students. *Research Quarterly for Exercise and Sport*, 77(Supplement), A-64.
- Maeland, A.F., & Trondheim, U. (1992). Self-esteem in children with and without motor coordination problems. *Scandinavian Journal of Educational Research*, 36, 313–321.
- Mazzoni, E.R., Southward, J.K., Temple, V.A., Rhodes, R.E., Virji-Babul, N., & Purves, L.P. (2006). Effect of indoor rock climbing on self-efficacy and self-perceptions of children with special needs: A pilot project. *ACHPER Healthy Lifestyles Journal*, 53, 10–16.
- Ministry of Education. (1995). *Special education services: A manual of policies, procedures and guidelines*. Victoria, BC: Special Education Branch.

- Nunnally, J.C. (1978). *Psychometric theory* (2nd ed.). New York: McGraw-Hill.
- Ninot, G., Bilard, J., Delignières, D., & Sokolowski, M. (2000). Effects of integrated sport participation on perceived competence for adolescents with mental retardation. *Adapted Physical Activity Quarterly*, *17*, 208–221.
- Piek, J.P., Dworcan, M., Barrett, N.C., & Coleman, R. (2000). Determinants of self-worth in children with and without developmental coordination disorder. *International Journal of Disability Development and Education*, *47*, 259–272.
- Rose, B., Larkin, D., & Berger, B.G. (1997). Coordination and gender influences on the perceived competence of children. *Adapted Physical Activity Quarterly*, *14*, 127–140.
- Rose, E., & Larkin, D. (2002). Perceived competence, discrepancy scores, and global self-worth. *Adapted Physical Activity Quarterly*, *19*, 127–140.
- Sarrazin, P., Roberts, G., Cury, F., Biddle, S., & Famouse, J. (2002). Exerted effort and performance in climbing among boys: The influence of achievement goals, perceived ability and task difficulty. *Research Quarterly for Exercise and Sport*, *73*, 425–436.
- Schoemaker, M.M., Smits-Engelsman, B.C.M., & Jongmans, M.J. (2003). Psychometric properties of the Movement Assessment Battery for Children-Checklist as a screening instrument for children with a developmental co-ordination disorder. *The British Journal of Educational Psychology*, *73*, 425–441.
- Schuengel, C., Voorman, J., Stolk, J., Dallmeijer, A., Vermeer, A., & Becher, J. (2006). Self-worth, perceived competence, and behaviour problems in children with cerebral palsy. *Disability and Rehabilitation*, *28*, 1251–1258.
- Shapiro, D.R., & Dummer, G.M. (1998). Perceived and actual basketball competence of adolescent males with mild mental retardation. *Adapted Physical Activity Quarterly*, *15*, 179–190.
- Shapiro, D.R., Moffett, A., Lieberman, L., & Dummer, G.M. (2008). Domain-specific ratings of importance and global self-worth of children with visual impairments. *Journal of Visual Impairment & Blindness*, *102*, 232–244.
- Shavelson, R.J., Hubner, J.J., & Stanton, G.C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research*, *46*, 407–411.
- Sonstroem, R.J., Harlow, L.L., & Josephs, L. (1994). Exercise and self-esteem: Validity of model expansion and exercise associations. *Journal of Sport & Exercise Psychology*, *16*, 29–42.
- Spence, J.C., McGannon, K.R., & Poon, P. (2005). The effect of exercise on global self-esteem: A quantitative review. *Journal of Sport & Exercise Psychology*, *27*, 311–334.
- Stiehl, J., & Ramsey, T. (2005). *Climbing walls: A complete guide*. Champaign, IL: Human Kinetics.
- van Rossum, J.H.A., & Vermeer, A. (1990). Perceived competence: A validation study in the field of motoric remedial teaching. *International Journal of Disability Development and Education*, *37*, 71–81.
- Watson, L., & Knott, F. (2006). Self-esteem and coping in children with developmental coordination disorder. *British Journal of Occupational Therapy*, *69*, 450–456.
- Watts, P., & Drobish, K. (1998). Physiological responses to stimulated rock climbing at different angles. *Medicine and Science in Sports and Exercise*, *30*, 1118–1122.