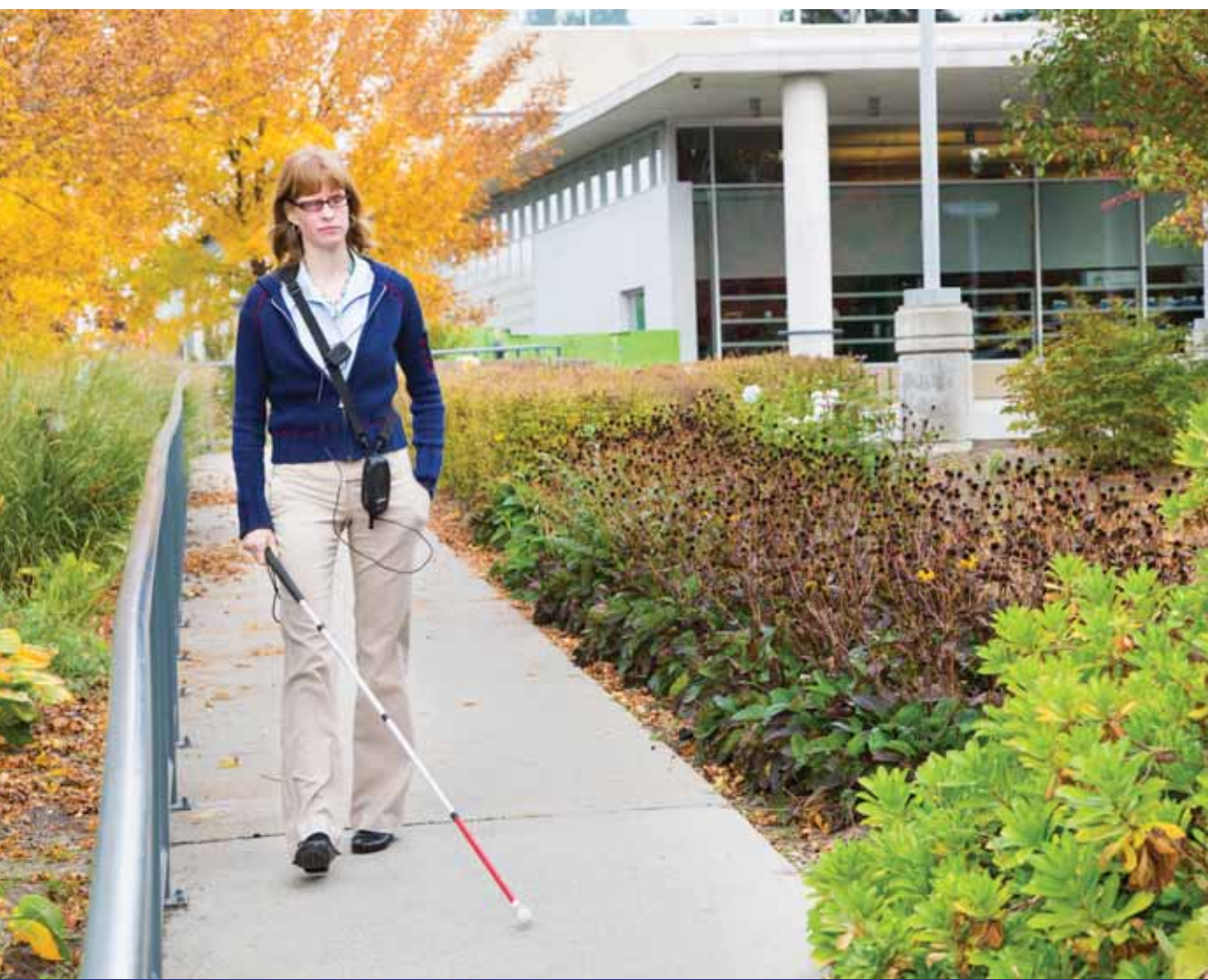


# Insight:

## Research and Practice in Visual Impairment and Blindness

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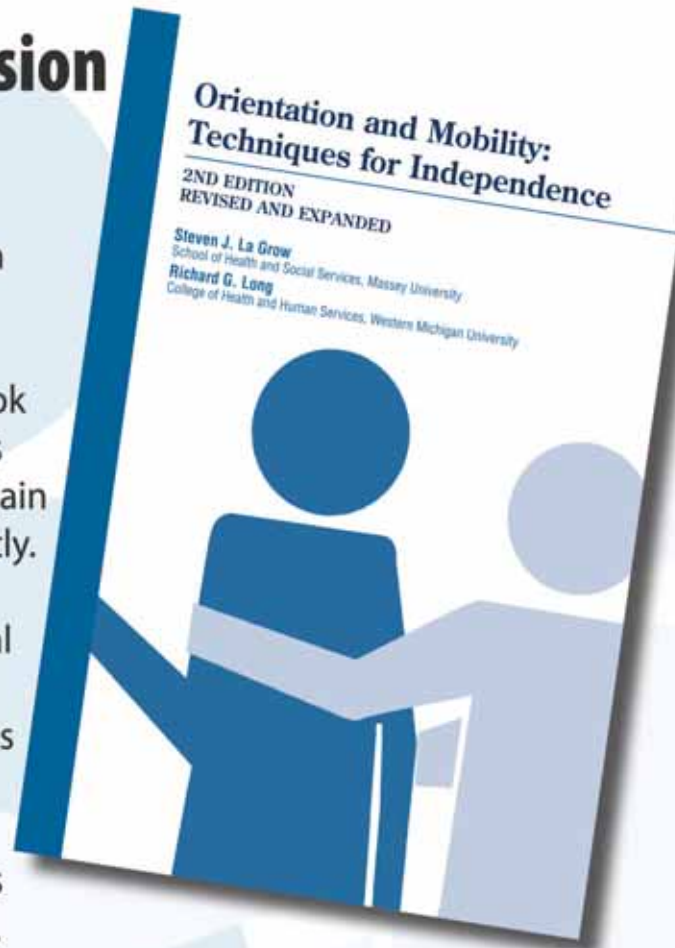


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## **Insight: Research and Practice in Visual Impairment and Blindness**

**A quarterly journal in the field of education and rehabilitation of persons of all ages with low vision or blindness**

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Cover photo caption: Chelsea Mohler uses her talking GPS to help her stay physically active. Cover photo courtesy of Alex Shaw Photography, [www.alexshaw.ca](http://www.alexshaw.ca).

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Well, this is farewell (but not good-bye, of course). “Fare well” is such an appropriate salutation here—meaning, “I hope you fare well as you go forward into the future.” It is far less final than “good-bye” and implies we might meet again. This, as AER members know, is the last issue of *Insight* and, thus, my last issue as Editor. I would like to take this opportunity to thank the editorial group for all of their hard work on the 17 journal issues we produced as an association over the past 4 years. This was hard work for many, and a labor of love also. The current issue comprises the last of the accepted manuscripts before we announced the end of the journal.

Three very different types of research are published in our Original Research section here. In the first, my colleagues Drs. Shaw, Flack, Smale, and I describe a study on physical activity in youths, conducted in Canada. We explored the application of a negotiation/constraints model of physical activity with this population for the first time. Although its use is more common with other groups, it has not been applied to people who are blind or visually impaired. If you want to know what we found, please peruse the article! What is great about this model is that it is not simply barrier focused. It assumes that when there are barriers, there are also “negotiation strategies” we all use to overcome them. Some of us (no matter our abilities and disabilities) are more able or inclined than others to employ these strategies.

In the second research article, Dr. Fok reports on a scoping review of the literature to gain perspective on what study participants with low vision deemed to be important during the selection of assistive technology and mainstream products. What a useful contribution to this area of low vision rehabilitation! The results of this review of the literature will, as the author states, inform and provide direction to subsequent qualitative and quantitative research studies.

In our third research article, Drs. Kapperman, Sticken, and Smith, report on a follow-up study to evaluate both the immediate and longer-term effectiveness of a software tutorial that can be installed on the BrailleNote and used by students who are blind to learn the Nemeth Code of Braille Mathematics and Science Notation. Their findings are helpful for those wishing to use tutorials as teaching aids, and they are also indicative of the usefulness of pre- and posttest evaluations, including longer-term follow-up, to see if the effects are lasting.

For the past few years, *Insight* has published what we have called “theory papers” as an alternative type of contribution to the literature, one not typically accepted in most rehabilitation journals. More typical of the humanities, this approach permits authors to reflect on an aspect of their field that is puzzling and requires investigation theoretically. Teachers will be very pleased to read one such excellent article by Dr. Kelly, who demonstrates how, by applying the learning theories of social cognition, self-determination, and constructivism to the field of visual impairment, various key characteristics can be fostered in learners through assistive technology-supported learning experiences.

The Practice Report in this issue, by B. J. LeJeune and Alberta L. Orr, describes the new online Transition Activity Calendar, a tool that provides suggestions for identifying a career goal and taking the necessary classes toward that career, and how to take every advantage of the transition services available in each student’s community. Extremely useful for vocational rehabilitation counselors and teachers alike, the activity calendar will provide support to all of your work with adolescents learning about the workplace.

In our first Professional Corner piece in quite some time, Joan Tolla and Bob Walker describe the portable cane stand they constructed for a student. More than just a storage place, Ms. Tolla suggests that this stand does much more, and she provides the blueprint for orientation and

mobility instructors to re-create the stand for their own students!

The articles in this issue represent all of the important qualities of professionals in our field: ingenuity, creative thinking, passionate commitment to the success of our clients, and the application of innovation in order to make life the best it can be for people who are blind or visually impaired. And in so doing, they (we) become the best THEY (WE) can be, because effort combined with creativity equals success! I will end with a quote from Steve Jobs, which I think captures best the message I am trying to convey:

Your time is limited, so don't waste it living someone else's life. Don't be trapped by dogma—which is living with the results of other people's thinking. Don't let the noise of others' opinions drown out your own inner voice. And most important, have the courage to follow your heart and in-

tuition. They somehow already know what you truly want to become. Everything else is secondary.

It is my extremely humble opinion that because *Insight* has been owned and operated by AER, it has been able to provide a unique perspective and reflect the needs, approaches, and various flavors of our field. I would like to take this opportunity to encourage all those who want to write within this profession to do so. Please contribute. And if you have suggestions of ways in which knowledge can be better shared at AER, please send them to: [ginger@aerbvi.org](mailto:ginger@aerbvi.org).

A handwritten signature in black ink that reads "D. Gold." The signature is fluid and cursive, with a period at the end.

**Deborah Gold, PhD**  
**Editor-in-Chief**



# Finding a Way to Participate: Physical Activity, Constraints, and Strategies

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## Abstract

What happens to the physical activity participation of people who are visually impaired when they use “negotiation strategies” to overcome perceived barriers? Two hundred and four youths and young adults (aged 16 to 30) who were randomly drawn from the database of the Canadian National Institute for the Blind (CNIB) completed a telephone survey that inquired about their level of physical activity, their perception of constraints to participation, and the strategies they used in an effort to participate despite these constraints. A hierarchical linear regression was conducted to assess the independent contributions of sociodemographic variables (gender, age, and level of vision), constraints, and negotiation strategies (strategies to overcome barriers) to participation in physical activity. The results revealed that strategies to overcome barriers that were focused on the better management of time were predictive of participation after personal variables and constraints were controlled for. Furthermore, once the strategies that were used to negotiate constraints were included in the regression model, constraints were no longer significant predictors of participation in physical activity.

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**Keywords:** physical activity, visually impaired, blind, negotiation, constraint, barriers, fitness, sport

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Despite the well-documented benefits of physical activity and the risks associated with physical inactivity (e.g., heart disease,

stroke, breast cancer, and colon cancer), at least 60% of the global population fails to achieve the minimum recommendation for daily physical activity (World Health Organization, 2003). Among persons with disabilities, levels of physical activity are significantly

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lower, thereby placing this segment of the population at a heightened risk for secondary disabilities and health complications (Holbrook, Caputo, Perry, Fuller, & Morgan, 2009; Longmuir & Bar-Or, 2000; Oh, Ozturk, & Kobuz, 2004; Ray, Horvat, Williams, & Blasch, 2007). There is a paucity of research on physical activity levels among people with visual impairments (that is, those who are blind or have low vision); the little research that has been conducted, however, has found that the levels are lower than in the general population (Blessing, McCrimmon, Stovall, & Williford, 1993; Hopkins, Gaeta, Thomas, & Hill, 1987; Houwen, Hartman, & Visscher, 2010; Lieberman & McHugh, 2001). In comparison to other disability groups, people with visual impairments have one of the lowest levels of physical activity (Hyun-Kyoung, Ozturk, & Kobuz, 2004).

Holbrook et al. (2009) suggested that there are also differences between people with visual impairments and the sighted population in terms of the *quality* of physical activity in which they engage. Specifically, they found that people with visual impairments spend not only a comparatively smaller percentage of the day being physically active, but an average of less than 7% of their total active time each day at moderate or high intensities of physical activity. Furthermore, the literature on physical fitness has revealed that fitness levels among persons with visual impairments are typically low (e.g., Houwen et al., 2010; Lieberman & McHugh, 2001; Lieberman, Byrne, Mattern, Watt, & Fernandez-Vivo, 2010; Longmuir & Bar-Or, 2000). Lieberman and McHugh (2001), for example, found that children who are visually impaired were not only less fit than their sighted peers, but significantly less fit than those sighted children who were identified as “inactive” (using the Fitnessgram health-related fitness test). In addition, persons with visual impairments have been found to have reduced performance on various assessments of motor and movement-based skills (Houwen et al., 2010; Ray et al., 2007). This lower-

level performance of motor skills may be a consequence of poor physical fitness (and lesser involvement in physical activity) and may lead to a disengagement from physical activities and sports.

The potential benefits of physical activity may be even greater for young adults with visual impairments. One reason is that activities of daily living demand increased energy when one is visually impaired (e.g., Lieberman & McHugh, 2001). However, people who are visually impaired are often discouraged from participating in activities of daily living because of this extra demand and, as a result, fail to reap the health benefits from involvement in them. Poor fitness can also lead to the avoidance of or exclusion from social activities, since many group activities have a significant physical component, which is of particular concern for children with visual impairments in that research has documented social deficits among many of them (e.g., Hyun-Kyoung et al., 2004). According to Hyun-Kyoung et al. (2004), there may be serious long-term consequences of physical inactivity, which may include an adult life with fewer friendships, a lesser ability to develop relationships with work colleagues, and an inability to develop the necessary social skills to maintain successful employment. A resistance to physical activity can also result in poor posture and weight gain, which may, in turn, lead to body image issues and add to the social stigma that people who are visually impaired already face because of their visual impairments (Crocker, Major, & Steele, 1998).

## Variability in Activity Level Among Persons with Visual Impairments

While persons with a visual impairment participate in physical activity less frequently on average than members of the sighted population, they also differ from one another in their participation rates. For example, research has suggested that boys

with visual impairments may be more physically active than girls (e.g., Lieberman & McHugh, 2001) and that those who are younger may be more active than those who are older (e.g., Ayvazoglu, Oh, & Kozub, 2006; Kozub & Oh, 2004; Oh et al., 2004). Many people with visual impairments are highly physically active. Some are involved in specialized sports, such as tandem cycling, downhill skiing, and sailing, and there are blind elite athletes who have excelled at the highest levels in competitive sports (e.g., “Marla Runyan,” n.d.). Therefore, it behooves researchers to learn more about the factors that enable some persons to be highly physically active while others risk their overall health because of inactivity.

## The Constraints-Negotiation Process

According to Jackson (1997, p. 461), constraints are “factors that are assumed by researchers and perceived or experienced by individuals to limit the formation of leisure preferences and to inhibit or prohibit participation and enjoyment in leisure.” Crawford, Jackson, and Godbey (1991) differentiated among three types of constraints: intrapersonal, interpersonal, and structural. *Intrapersonal constraints* are defined as those that reside within the individual and can include such things as low self-esteem and low motivation. *Interpersonal constraints* are related to one’s relationships with others and could include the lack of tangible or emotional support from family members or friends. *Structural constraints* exist within the environment and include such things as the lack of convenient locations and of low-cost facilities. Research that has focused on the impact of such constraints on physical activity has suggested that the relationship between constraints and participation in physical activity is more complex than was previously thought.

Past research in the field of recreation and leisure has revealed an unexpected finding—the high presence of constraints

was not always linked to low participation rates (Alexandris, Tsorbatzoudes, & Grouios, 2002; Jackson, Crawford, & Godbey, 1993; Kay & Jackson, 1991). Specifically, some persons with high constraints were physically active, and many with few constraints were inactive. This finding was proposed to explain the phenomenon whereby people who encounter significant constraints to participation are still able to participate and, in some cases, to participate even more than their peers who experience fewer constraints. Hubbard and Mannell (2001) proposed a “constraint effects mitigation model” to describe this mediating effect of negotiation strategies on constraints. The premise behind the model is that constraints have two opposing effects. First, they inhibit participation, and, second, they trigger the use of negotiation strategies that have the effect of increasing participation. Negotiation was proposed to include specific strategies, such as financial, cognitive, and time-management tactics; interpersonal coordination; issue management; and the acquisition of skills.

Research on the constraint-negotiation process has been conducted with a number of populations, including older able-bodied park visitors (e.g., Son, Kerstetter, & Mowen, 2008), employees with access to corporate employee recreational fitness programs (Hubbard & Mannell, 2001), and persons with fibromyalgia (Loucks-Atkinson & Mannell, 2006). However, research to date has not explored the constraint-negotiation process among persons who are visually impaired.

The study presented here used the theoretical backdrop of Hubbard and Mannell’s (2001) constraint-negotiation process to explore how constraints and negotiation impact the participation in physical activity of persons who are visually impaired. It addressed the following questions: “Does the presence of constraints and the use of negotiation strategies account for individual differences in participation in physical activity among youths and young adults who are

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visually impaired?” and “Are these factors important above and beyond differences that are attributable to age, gender, and level of vision?” Finally, the study sought to identify the types of strategies that increase physical activity among youths and young adults who are visually impaired.

## Research Questions

On the basis of insights gained from previous research, the following questions were considered: How do constraints and negotiation strategies relate to participation in physical activity, and how does this relationship vary by gender, age, and level of vision? Do constraints impact participation even after personal factors (age, gender, and level of vision) are controlled for? Do negotiation strategies impact participation after both personal factors (such as age, gender, and level of vision) and perceived constraints are controlled for? What types of strategies are most effective at helping youths and young adults who are visually impaired overcome constraints to participation?

## Method

### Participants

The sample was drawn from the client database of the Canadian National Institute for the Blind (CNIB), a Canadian nationwide agency providing vision rehabilitation services to persons of all ages. A stratified sampling strategy was used to ensure the proportionate representation of each of the provinces of Canada. A final sample of 204 participants, including 105 females (52%) and 97 males (48%) (2 participants did not indicate their gender), were contacted by telephone and invited to participate in a survey that could be completed either over the telephone or online. In all, 63 participants were in the younger cohort (16 to 21 years), and 136 were in the older cohort (22 to 30 years) (5 participants did not disclose their age). Of those who were successfully contacted (including messages left on answering machines), the response rate was approximately 35%, excluding wrong numbers

and out-of-service numbers, answering machine messages (to which there were no return calls), and incomplete questionnaires.

## Instrumentation

The participants were asked to complete a questionnaire that incorporated standardized scales to measure levels of physical activity, constraints to participation, and negotiation strategies used to overcome constraints to involvement in physical activity. In addition, each participant reported basic demographic information, such as age, gender, and level of vision.

## Physical Activity Recall

Physical activity levels have traditionally been measured using either self-report or direct measures, and there are trade-offs with both approaches. Self-report measures have the potential to under- or overestimate energy expenditure levels for physical activity because they may be biased by social desirability, inaccurate recall, and difficulty gauging one's own level of activity (Prince et al., 2008). On the other hand, while direct measures may in many cases be more accurate, this accuracy depends on the specialized training of assessors and the proximity of participants; also, a wide range of direct measures are available, and no gold standard exists. However, research by Albright and Jerome (2011) suggested that specific devices, such as the Accusplit Alliance AL300 talking pedometer, may be well suited for both research and the promotion of physical activity. A systematic review by Prince et al. (2008) revealed that there is no consistent relationship between indirect and self-report measures. However, of the many self-report measures available, the International Physical Activity Questionnaire (IPAQ), according to Craig et al. (2003), has measurement properties that are at least on a par with other established self-reports. Also, these measurement properties of the IPAQ were based on diverse samples, so its generalizability may extend to a wider range of populations



than other similar physical activity self-recall measures.

### **IPAQ**

The IPAQ is available in a number of administration formats and in a variety of languages. For this study, the short English version was used (the self-administered version; see <http://www.ipaq.ki.se>). The IPAQ assesses physical activity levels in three categories—in which vigorous activity receives the greatest weight, followed by moderate physical activity, and walking. It also provides a formula for computing an overall score of energy expenditure, measured as a metabolic equivalent (MET) value (see Statistics Canada, 1995, Appendix F), expressed as a multiple of the resting metabolic rate; thus, an activity of 4 METs requires four times the amount of energy as when the body is at rest. The IPAQ was used in the study because of its favorable psychometric properties, its generalizability to diverse populations, and its availability as a self-report questionnaire. The short version of IPAQ was used because of its brevity, coupled with its demonstrated validity and reliability (Dinger, Behrens, & Han, 2006; Kurtze, Ranquil, & Hustvedt, 2008).

### **Constraints Scales**

A modified version of Loucks-Atkinson and Mannell's (2006) Leisure Constraints Scale was used to measure perceived barriers to physical activity faced by the participants. The original scale assessed constraints experienced in three categories: (1) structural constraints based on 7 items (e.g., access to transportation, having the financial means to participate), (2) interpersonal constraints based on 9 items (e.g., support from family and/or friends), and (3) intrapersonal constraints based on 7 items (e.g., having the necessary skills, beliefs). An additional 12 items created by the researchers were included in the scale, 4 of which were added to the structural constraint category (complementing existing items) and 8 of which formed a new cate-

gory focused on assessing constraints specific to the experience of vision loss (e.g., "I am afraid of getting hurt because of my visual impairment"), resulting in 35 total items. The 12 additional items were: "the weather," "I do not feel I can keep up with sighted peers," "I am afraid of getting hurt because of my visual impairment," "I do not feel safe getting to and from facilities," "my parents do not support my independent participation in activities outside the house," "I do not have a sighted guide who can help me get to facilities," "facilities are not accessible," "I do not see well in the evening and at night," "activities designed for people with vision loss are not locally available," "my friends who are visually impaired do not live nearby," "I lack the technical aids I require to participate," and "other" (participant could specify). The participants assessed each constraint on the extent to which they believed it prevented them from participating in physical activity along a 5-point scale ranging from "not at all prevented or inhibited" (value = 1) to "very much prevented or inhibited" (value = 5). Mean scores were calculated for all the items in each of the three original categories of constraints and for the 8 items constituting the visual impairment-specific constraints.

The overall reliability of the Leisure Constraints Scale (without the additional items and with populations who were not visually impaired) has been found to be acceptable (e.g.,  $\alpha = .72$  in Hubbard & Mannell, 2001), and the constraints subscales were found to be acceptable for interpersonal ( $\alpha = .73$ ) and intrapersonal ( $\alpha = .76$ ) constraints, and low but acceptable for structural constraints ( $\alpha = .58$ ) (Stanis, Sonja, Schneider, & Russell, 2009). Since this scale has not been used with a visually impaired population, there are no population-specific validity and reliability estimates available in the literature. However, the main results of the current study revealed that the reliability scores for the modified version of the Leisure Constraints Scale were acceptable for structural ( $\alpha = .81$ ), interpersonal ( $\alpha = .84$ ),



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**Table 1.** Descriptive Statistics and Scale Reliabilities for Constraints and Negotiation Strategies

Factor	Number of Items	Mean	SD	Cronbach's alpha
<b>Constraints<sup>a</sup></b>				.90 <sup>c</sup>
Structural	11	2.25	.78	.81
Interpersonal	9	1.77	.71	.84
Intrapersonal	7	1.99	.80	.80
Sight-specific	8	2.10	.82	.70
<b>Negotiation Strategies<sup>b</sup></b>				.89 <sup>c</sup>
Changing aspirations	6	2.61	.80	.72
Improving finances	4	3.05	.93	.54
Changing interpersonal relations	7	2.72	.77	.74
Coping	8	2.25	.74	.72
Acquiring new skills	4	2.60	.78	.63
Managing time	9	2.68	.68	.75

<sup>a</sup> Based on a 5-point scale from 1 = “not at all prevented or inhibited” to 5 = “very much prevented or inhibited.”

<sup>b</sup> Based on a 5-point scale from 1 = “never” to 5 = “very often.”

<sup>c</sup> Cronbach's alpha for constraints and negotiation strategies based on the composite measures (not the individual items).

and intrapersonal ( $\alpha = .80$ ) constraints, as well as for sight-specific constraints ( $\alpha = .70$ ) (see Table 1).

**Negotiation Strategies Scales**

The Loucks-Atkinson and Mannell (2006) Leisure Negotiation Scale was used to explore the use of different negotiation strategies for overcoming constraints to leisure activities. This scale is comprised of 37 negotiation strategies that are organized in the following six categories: (1) changing aspirations, based on 5 items (e.g., modifying the activity); (2) improving finances, based on 4 items (e.g., budgeting one's finances); (3) changing interpersonal relations, based on 6 items (e.g., participating with different people); (4) coping, based on 10 items (e.g., using relaxation techniques); (5) acquiring new skills, based on 3 items (e.g., taking lessons); and (6) using time-management strategies, based on 9 items (e.g., learning to schedule). Two of the items in the coping category of Loucks-Atkinson and Mannell (2006) were dropped because of their specificity to a different

population (e.g., “I have learned to predict my pain and participate despite having fibromyalgia” and “I reduce the intensity of participation or effort that I put into participation”) and 3 new items specific to a population with visual impairments (“I take advantage of coaching available for people with vision loss,” “I am assertive and ask for my right to access facilities,” and “I have found physically active leisure activities that are less dependent on vision”) were added to the categories of changing aspirations, changing interpersonal relations, and acquiring new skills.

As with the Leisure Constraints Scale, the resultant scales were pilot-tested to confirm that items were clear and easily understood. The final scale, therefore, consisted of 38 items across the six categories of negotiation strategies. The participants indicated the extent to which they used each specific negotiation strategy to overcome constraints to physical activity along a 5-point scale ranging from “never” (value = 1) to “very often” (value = 5). Mean scores were calculated for all the

items in each of the six categories of negotiation strategies.

The Leisure Negotiation Scale has not been previously used with people who are visually impaired. However, past use of the scale with other populations has shown it to be reliable. For example, Stanis et al. (2009) found the scale to have a reliability of  $\alpha = .88$  overall and between .71 and .80 for each of its subscales. Hubbard and Mannell (2001) found the scale to have an overall reliability of .89 and scale alphas of .61 to .89. The results of the current study also showed that estimates of reliability for the current modified version of the scale were acceptable for subscales of changing aspirations ( $\alpha = .72$ ), changing interpersonal relations ( $\alpha = .74$ ), coping ( $\alpha = .72$ ), and managing time ( $\alpha = .75$ ), and given the small number of items, also acceptable for acquiring new skills ( $\alpha = .63$ ). The reliability estimate for "improving finances" ( $\alpha = .54$ ) was only marginally acceptable, likely because of the smaller number of items in the subscale (see Table 1) and perhaps because of the varied financial circumstances for this younger sample (i.e., some in school and some working).

## Procedure

After ethics approval was received from the University of Waterloo Research Ethics Board, prospective participants were selected randomly from the CNIB database using SPSS statistical software and were then contacted by telephone by research assistants located across Canada and invited to participate in the study. The participants were treated in accordance with ethical standards of the Tripartite Council of Canada. The callers followed a script in which they described the benefits of the study and the voluntary nature of participation. In the case of youths younger than age 18, parental consent was obtained verbally before the youths were asked if they wished to participate. Participants who provided informed consent to participate were given the option of completing a survey either over the telephone (with an interviewer) or

online on their own time. Those who chose the online option were assigned a unique identification number that they entered when they accessed the website, to ensure that the submitted online surveys were from legitimate participants (not from persons who happened on the survey website) and to enable the researchers to follow up with persons who agreed to complete the survey online but who had not done so within a two-week period.

## Analysis

To ensure reasonable accuracy in the participants' self-reported estimates of physical activity (the data processing procedure involved a number of data-cleaning steps, including the exclusion of extreme outliers and the truncation of data when estimates were judged to be unreasonably high, prior to use of a formula for computing Total MET minutes per week), the results from the IPAQ were coded and analyzed in accordance with the *Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire* (2005) provided by the developers of the tool. Coding and analyses yielded an overall MET score for each participant. This score reflects the intensity of the participant's participation in all forms of physical activity. Analyses of the rest of the data collected from the participants included three steps. First, using the mean scores generated for each constraint and negotiation strategy subscale, the data were examined to determine which constraints and negotiation strategies were reported most frequently by the participants. Second, *t*-tests were conducted to examine differences in the occurrences of various constraints and the use of the negotiation strategies based on age, gender, and level of vision. The participants were classified on the basis of their level of vision into one of two groups: those with no usable vision (including those with light perception) and those with some usable vision. Although data on their functional vision levels were available in the CNIB database on the basis

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**Table 2.** MET Scores of the Participants in Comparison with Youths and Young Adults in the General Population

Factor	18–30 General	Males General	Females General	16–32 with Vision Loss	Males with Vision Loss	Females with Vision Loss
Mean	4,407.64	5,089.40	3,642.21	3,657.91	3,368.92	3,944.65
95% confidence interval of the mean lower bound	4,226.57	4,829.10	3,407.66	3,149.49	2,626.1	3,232.07
95% confidence interval of the mean upper bound	4,588.72	5,349.71	3,876.76	4,166.32	4,111.73	4,657.22

of WHO criteria, the ethics review board required that data on clients not be linked to the study’s database. Finally, a three-step hierarchical regression analysis was conducted using SPSS to assess the independent contributions of the participants’ characteristics (age, gender, and vision level), constraints, and negotiation strategies on participation in physical activity against the backdrop of the constraint-effects mitigation model proposed by Hubbard and Mannell (2001). In the cases of gender and level of vision, dummy variables were created to facilitate their use in the regression analysis. For gender, female was coded 1, and male was coded 0; for level of vision, the participants with no usable vision or only light perception were coded 1, and those with some vision were coded 0.

Results

Demographic Characteristics

Most participants (86%) lived in urban centers. In the younger cohort (aged 16–21), 35% (*n* = 21) were employed; in the older cohort (aged 22–30), 42% (*n* = 55) were employed. Sixty-four percent (*n* = 40) of the participants in the younger cohort were currently students, compared with 24% (*n* = 32) in the older cohort. In the younger cohort, 82% (*n* = 35) had a personal income of \$10,000 or less, compared

to 51% (*n* = 48) in the older cohort. The participants were asked to report on whether they had “some usable vision,” “light perception only,” or “no usable vision.” Of those who had some usable vision, 68% (*n* = 40) were in the younger cohort, and 78% (*n* = 100) were in the older cohort. Almost all the participants in the younger cohort (90.5%, *n* = 57), and 85.8% (*n* = 115) who were in the older cohort reported that they were in good to excellent health. Seventy-four percent of the participants (*n* = 42) in the younger cohort and 59% (*n* = 77) of the participants in the older cohort claimed that they had no additional disability or chronic health condition that affected their day-to-day lives.

Physical Activity Levels

Compared to the data tabulated by the Canadian Fitness and Lifestyle Research Institute (CFLRI) (2009) (based on 1,172 youths and young adults aged 18 to 30), the mean MET score of all the participants with visual impairments in the current study was lower (3,657.91) than for youths and young adults in the general population (4,407.64) of Canada. An examination of confidence intervals suggests that this difference is unlikely to be the result of chance or of differences in the shapes of the distributions of the two populations (see Table 2).

A separate examination of males revealed a parallel, but more pronounced, difference in physical activity levels. While the mean MET score for males in the general population is 5,089, the mean for males with visual impairments in the current study was only 3,368. On the basis of confidence intervals, this difference is also likely to be statistically significant (see Table 2). Observed differences between sighted females and females with visual impairments appeared to be negligible once confidence intervals were taken into account.

For youths and young adults with no usable vision (i.e., those with light perception or less), the difference between their level of physical activity ( $\chi = 2,514$ ) and that of sighted youths and young adults ( $\chi = 4,408$ ) was even more pronounced. Furthermore, females with no usable vision ( $\chi = 2,235$ ) were even less physically active than their sighted female peers ( $\chi = 3,642$ ) and likely to a significant degree again on the basis of an examination of confidence intervals (see Table 2).

### Constraints (Barriers)

In both the younger and older cohorts, the participants reported structural constraints (environmental barriers) as the greatest inhibitors to physical activity ( $M = 2.25$ ,  $SD = .78$ ), followed by sight-specific constraints ( $M = 2.10$ ;  $SD = .82$ ), and intrapersonal constraints (barriers within the person) ( $M = 1.99$ ,  $SD = .80$ ). Interpersonal constraints (barriers related to relationships with others) were least often cited as barriers ( $M = 1.77$ ,  $SD = .71$ ) (see Table 1). The variability in scores was similar on all three types of constraints and relatively low, suggesting some consensus among the participants in their perceptions of these barriers to their participation.

The participants in both age cohorts who reported that they had some usable vision experienced fewer constraints than did those with light perception or less in all three categories of constraints. Although the differences between the two groups were relatively small on both structural con-

straints,  $t(173) = 1.834$ ,  $p = .068$ , and intrapersonal constraints,  $t(175) = 1.841$ ,  $p = .067$ , there was a trend toward significance. The female participants perceived more constraints than did the male participants in all three categories of constraints (see Table 3). These differences were statistically significant in the case of structural constraints,  $t(182) = -3.040$ ,  $p = .003$ , and intrapersonal constraints,  $t(184) = -4.052$ ,  $p < .001$ , and they approached significance in the case of interpersonal constraints,  $t(183) = -1.691$ ,  $p = .093$ .

### Negotiation Strategies

Among the six categories of negotiation strategies, across both cohorts, improving one's financial circumstances was used the most often ( $M = 3.05$ ,  $SD = .93$ ), followed by changing one's interpersonal relationships ( $M = 2.72$ ,  $SD = .77$ ), and adopting different time-management strategies ( $M = 2.68$ ,  $SD = .68$ ) (see Table 1). Coping strategies as a means of negotiating through constraints were used the least often ( $M = 2.25$ ,  $SD = .74$ ). The various negotiation strategies were used to the same extent by both the younger and older cohorts, and although the participants with some usable vision consistently used all six strategies more than did those with no usable vision, these differences were not statistically significant. The pattern of mean scores suggests that the females with visual impairments made greater use of negotiation strategies in all six categories than did the males (see Table 3). Furthermore,  $t$ -tests revealed that these differences were statistically significant in the case of changing aspirations,  $t(181) = -2.434$ ,  $p = .016$ , and coping strategies,  $t(178) = -2.421$ ,  $p = .016$ .

### Relationships Among Participation in Physical Activity, Constraints, and Negotiation Strategies

Correlational analyses revealed that greater perceived intrapersonal constraints (constraints within a person) were associ-

Table 3. Perceptions of Constraints and Use of Negotiation Strategies by Gender

Factor	Males		Females		<i>t</i>	<i>p</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>		
<b>Constraints<sup>a</sup></b>						
Structural	2.03	.71	2.42	.81	−3.040	.003
Interpersonal	1.68	.69	1.86	.72	−1.691	.093
Intrapersonal	1.76	.70	2.21	.83	−4.052	<.001
Sight specific	1.99	.80	2.21	.83	−1.790	.075
<b>Negotiation Strategies<sup>b</sup></b>						
Changing aspirations	2.45	.77	2.74	.81	−2.434	.016
Improving finances	2.96	1.00	3.11	.86	−1.066	.288
Changing interpersonal relations	2.65	.80	2.78	.75	−1.191	.235
Coping	2.11	.73	2.37	.72	−2.421	.016
Acquiring new skills	2.59	.85	2.60	.71	−.075	.940
Managing time	2.64	.73	2.72	.63	−.868	.387

<sup>a</sup> Based on a 5-point scale from 1 = “not at all prevented or inhibited” to 5 = “very much prevented or inhibited.”

<sup>b</sup> Based on a 5-point scale from 1 = “never” to 5 = “very often.”

ated with lower overall levels of physical activity ( $r = -.196, p = .011$ ). Structural constraints (environmental barriers) and interpersonal constraints (those associated with interrelationships with others) were not found to be significantly associated with participation in physical activity. Correlational analyses also revealed that the greater use of negotiation strategies overall was significantly related to higher levels of participation in physical activity ( $r = .329, p < .001$ ). In fact, higher physical activity levels overall were associated with the greater use of all six categories of negotiation strategies: managing time ( $r = .368, p < .001$ ), acquiring skills ( $r = .296, p < .001$ ), changing interpersonal relationships ( $r = .288, p < .001$ ), improving finances ( $r = .270, p = .001$ ), coping ( $r = .186, p = .017$ ), and changing aspirations ( $r = .184, p = .018$ ).

A hierarchical linear regression analysis was conducted to examine the independent contributions of three sets of factors on variations in overall participation in physical activity, measured using the METs value. In the first stage, the factors gender, age, and level of vision were entered in the regres-

sion to control for the variations they explain in participation in physical activity. In the second stage, subscales of the constraints scale and a composite score for sight-specific constraints were entered. In the final stage, subscales of the negotiation strategies scale were entered to determine if they collectively and/or individually explained significant variations in participation above and beyond the effects of personal factors and perceived constraints.

In the first stage of the regression model, neither the model as a whole ( $F = 1.665, p = .177$ ) nor any of the factors (gender, age, or level of vision) accounted for a significant amount of the variation in the MET scores (see Table 4). However, although not statistically significant, individuals with only light perception or less vision appeared to report lower rates of physical activity ( $\beta = -.156, p = .064$ ) than their peers with some usable vision.

In the second stage of the model, the four constraint measures (“structural,” “interpersonal,” “intrapersonal,” and “sight specific”) accounted for a statistically significant 10.5% of the variability in the MET scores ( $F = 2.286, p = .031$ ); however, only intra-



**Table 4.** Hierarchical Regression Analysis of the Influence of Constraints and Negotiation Strategies on Participation in Physical Activity (METs Value)

Factor	Model 1		Model 2		Model 3	
	$\beta$	$p$	$\beta$	$p$	$\beta$	$p$
Female <sup>a</sup>	.072	.393	<b>.184</b>	<b>.043</b>	.129	.150
Age	−.080	.338	−.061	.458	−.077	.334
Level of vision <sup>b</sup>	−.156	.064	−.157	.058	−.085	.294
<b>Constraints</b>						
Structural	.003	.981	.085	.540		
Interpersonal	−.106	.412	−.151	.236		
Intrapersonal	<b>−.379</b>	<b>.003</b>	−.234	.074		
Sight specific	<b>.320</b>	<b>.024</b>	.186	.190		
<b>Negotiation Strategies</b>						
Changing aspirations	−.155	.181				
Improving finances	−.027	.818				
Changing interpersonal relations	.089	.460				
Coping	.025	.825				
Acquiring new skills	.073	.543				
Managing time	<b>.343</b>	<b>.013</b>				
N	144	144		144		
Total variance ( $R^2$ )	.034	−.105		−.219		
F	1.665	2.286		2.799		
p	.177	−.031		−.001		

<sup>a</sup>A binary variable indicating the degree to which “being female” contributes to participation in physical activity.

<sup>b</sup>A binary variable indicating the degree to which “no or some light vision” contributes to participation in physical activity.

personal and sight-specific constraints were significantly related to participation in physical activity. As expected, participation was lower as intrapersonal constraints were experienced more ( $\beta = -.379, p = .003$ ). However, contrary to expectations, as sight-specific constraints were experienced more, participation was actually found to be higher ( $\beta = .320, p = .024$ ).

In the last stage, negotiation strategies were introduced to the model. The full model, which included negotiation strategies, constraints, and inherent characteristics of the participants (age, gender, and level of vision), accounted for 21.9% of the variance in the physical activity scores and was statistically significant ( $F = 2.799, p < .001$ ). Once negotiation strategies were introduced to the mix of factors explaining

variations in participation, none of the constraints was significant, including constraints that were sight specific. The only negotiation strategy that had a statistically significant influence on physical activity after the other factors were controlled for was managing time ( $\beta = .343, p = .013$ ). That is, when individuals make greater use of time-management negotiation strategies, irrespective of the constraints that they face, they participate more in physical activity.

Discussion

Are youths and young adults who are visually impaired less physically active than youths and young adults in the general population? The comparison of the data on the sample with aggregate data from the CFLRI

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suggests that both males and females with visual impairments have activity levels that are not dissimilar to those of sighted females. Sighted males, on the other hand, appear to have activity levels that are significantly higher than those of sighted females, males with vision loss, and females with vision loss. On the other hand, a comparison of the participants with no usable vision with their sighted counterparts revealed overall that they are even less physically active and that this difference is evident even in comparison to sighted females.

Past research in the area of leisure studies has suggested that in the general population, gender is related to physical activity levels; specifically, females have typically been found to be less physically active than males (e.g., Colley et al., 2011; Son et al., 2008), as are those who are older (e.g., Stanley & Freysinger, 1995). Yet, as is consistent with previous research with people with visual impairments (e.g., Holbrook et al., 2009), differences between males and females were not found in this sample. One reason provided in the literature for why activity levels among sighted males are typically higher than those among sighted females is that the males are more likely to engage in group sports, which, by their nature, entail more vigorous activity (which is weighted more heavily in the calculation of the overall MET score). However, males with visual impairments may not be as involved in many of these group sports, since these sports depend more on sight; this would explain why their rates of participation in this sample were similar to those of their female counterparts.

Although the female participants were as active as the male participants, they were significantly more likely than the male participants to report constraints of all forms. This finding raises the question of why the greater perception of constraints did not translate into lower levels of physical activity. One explanation stems from the finding that the female participants were also sig-

nificantly more likely than the male participants to use negotiation strategies to overcome these barriers. This was shown to be the case for all categories of negotiation strategies and significantly so for the categories of changing aspirations and using coping strategies. The female participants might therefore have been compensating, in part, for these barriers by a making greater use of negotiation strategies.

Although those with better vision were more physically active than were those whose vision was much more limited, the level of vision did not emerge as a statistically significant predictor of physical activity levels. This observation was further supported by a large drop in the effect of the level of vision once negotiation strategies were introduced into the regression model, indicating that the level of vision was even less important a factor in explaining variations in participation in physical activity after negotiation strategies were considered. The implication of the findings related to age, gender, and level of vision to participation is that little of the variability in physical activity levels among the participants can be explained by these factors.

Of the three categories of constraints described by Crawford et al. (1991)—intrapersonal, interpersonal, and structural—only the intrapersonal barriers were significantly related to levels of participation. Intrapersonal constraints are those that are within us and include perceptions of whether or not we can do something and our feelings of confidence in pursuing such activities. It is interesting that structural constraints (environmental barriers) were not significantly related to levels of physical activity, yet they were the type of constraint most frequently cited by the participants. These findings suggest that the actual barriers encountered by people with visual impairments are less critical to participation in physical activity than the limitations perceived by the self and that the perception of structural constraints may be mediated by one's self-concept, motivational level, confidence,

coping skills, and perception of one's abilities (Jackson et al., 1993).

It is unclear why the presence of sight-specific constraints seems to increase levels of physical activity when one would expect that greater constraints related to vision would be associated with lower activity levels. One possibility is that those who are more actively engaged in physical activity are also more aware of the constraints to participation, especially as they pertain to their visual impairments, and therefore are more likely to report them.

The results revealed two important findings with respect to negotiation strategies. First, the effect of constraints on participation was not significant once negotiation strategies were considered. Second, a model that included negotiation strategies accounted for almost 22% of the variance in the physical activity scores. These findings are consistent with a "constraint effects mitigation model" in which negotiation strategies mitigate the interference of constraints on participation (Hubbard & Mannell, 2001).

It is interesting that of the specific negotiation strategies, only managing time was a statistically significant factor associated with higher levels of physical activity after constraints and personal factors were controlled for. Specifically, the greater use of time-management strategies is associated with greater participation. This finding has several important implications. First, it suggests that negotiation strategies do not need to be sight specific to be effective in helping persons with visual impairments, since actively managing one's time turns out to be more effective than other strategies in ensuring participation in physical activities. Consistent with this finding, Tsai and Coleman (2009) reported in their review of different kinds of self-efficacy in a student population that "scheduling self-efficacy" may be a prerequisite for the other forms of self-efficacy to be effective. Therefore, it may be a combination of believing that one has viable time-management skills and a willingness to use them that can

make the biggest difference in participation. Because it is typical for persons with visual impairments to take more time to complete activities of daily living (Lieberman & McHugh, 2001), it appears that it is also critical in ensuring participation and engagement in physical activities. Within the context of this study, some of the time-management strategies included: "I try to plan ahead for things"; "when at work/school, I work hard so that I can have more time for physically active leisure activities"; and "I get up earlier or stay up later to increase time for physically active leisure activities." However, given the strong evidence in this study of a powerful role of time-management strategies, it would be fruitful to expand this list to include a wider range of time-management strategies.

The findings of the study demonstrate that barriers or constraints to activity do not necessarily determine the level of involvement. Nor is it the case that variations in activity levels among youths and young adults who are visually impaired can be reduced to the impact of gender, age, or level of vision. The results indicate that the use of negotiation strategies, particularly time-management strategies, make the greatest difference in levels of participation. Therefore, a clear implication of the study is that direct instruction in the use of negotiation strategies, particularly time-management strategies, can be used to help youths and young adults who are blind or have low vision become more active physically.

## Limitations

There were several notable limitations in the study. First, the scales that were used, including the constraints scale, the negotiation strategies scale, and the IPAQ, have not been validated for use with persons who are visually impaired. Nor have the questions that were added specifically for this sample been validated. Alternative scales to measure the constructs in this study and validated with people who are visually impaired are simply not available. With a much larger sample of participants, the fac-

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tor structure in this population could have been examined and validity possibly established, thus lending additional credence to the results. In addition, an examination of the data through Rasch-based analyses in recognition of the ordinal nature of Likert scale responses could yield different findings.

Second, there are some cautions regarding the generalizability of the findings because the participants were drawn from the CNIB database and may or may not be fully representative of youths and young adults with visual impairments in Canada or other countries. Also, the findings are limited to youths and young adults aged 16 to 30 and may not apply to younger or older age groups (e.g., Son et. al., 2008).

## Future Research

The findings of the study provide strong support for the role of negotiation strategies in increasing physical activities for young people with visual impairments, despite clear barriers. However, the mechanisms behind this process have still not been fully explored. Future research could examine further the roles of locus of control, self-esteem, motivation, and family support in the use of negotiation strategies for people who are visually impaired. Qualitative studies, along with ongoing quantitative research, will also help to clarify the processes and interactions of these variables.

## References

Albright, C., & Jerome, G. J. (2011). Accuracy of talking pedometers during free-living: Comparison of 4 models. *Journal of Visual Impairment & Blindness*, 105, 299–304.

Alexandris, K., Tsorbatzoudes, C., & Grouios, G. (2002). Perceived constraints on recreational sport participation: Investigating their relationship with intrinsic motivation, extrinsic motivation, and amotivation. *Journal of Leisure Research*, 34, 233–252.

Ayvazoglu, N. R., Oh, H. K., & Kozub, F. M. (2006). Explaining physical activity in children with visual impairments: A family systems approach. *Exceptional Children*, 72, 235–248.

Blessing, D. L., McCrimmon, D., Stovall, J., & Williford, H. N. (1993). Effects of regular exercise programs for visually impaired and sighted schoolchildren. *Journal of Visual Impairment & Blindness*, 87, 50–52.

Canadian Fitness and Lifestyle Research Institute. (2009). *Survey of physical activity in Canadian communities* [Aggregate data file]. Ottawa, ON: Author.

Colley, R., Garriguet, D., Janssen, I., Craig, C., Clarke, J., & Tremblay, M. (2011). Physical activity of Canadian children and youth: Accelerometer results from the 2007 and 2009 Canadian Health Measures Survey. *Health Reports*, 22(1), 15–23.

Craig, C., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., et al. (2003). International Physical Activity Questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise*, 35, 1381–1395.

Crawford, D. W., Jackson, E. L., & Godbey, G. (1991). A hierarchical model of leisure constraints. *Leisure Sciences*, 13, 309–320.

Crocker, J., Major, B., & Steele, C. (1998). Social stigma. In D. Gilbert, S. T. Fiske, & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., Vol. 2, pp. 504–553). New York: McGraw Hill.

Dinger, M., Behrens, T. K., & Han, J. L. (2006). Validity and reliability of the International Physical Activity Questionnaire in college students. *American Journal of Health Education*, 36, 337–343.

*Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ). Short and long forms.* (2005). Retrieved from <http://www.ipaq.ki.se/scoring.pdf>

Holbrook, E. A., Caputo, J. L., Perry, T. L., Fuller, D. K., & Morgan, D. W. (2009). Physical activity, body composition, and perceived quality of life of adults with visual impairments. *Journal of Visual Impairment & Blindness*, 103, 17–29.

Hopkins, W. G., Gaeta, H., Thomas, A. C., & Hill, P. M. (1987). Physical fitness of blind and sighted children. *European Journal of Applied Physiology and Occupational Physiology*, 56(1), 69–73.

Houwen, S., Hartman, E., & Visscher, C. (2010). The relationship among motor proficiency, physical fitness, and body composition in children with and without visual impair-



- ments. *Research Quarterly for Exercise and Sport*, 81, 290–299.
- Hubbard, J., & Mannell, R. C. (2001). Testing competing models of the leisure constraint negotiation process in a corporate employee recreation setting. *Leisure Sciences*, 23, 145–163.
- Hyun-Kyoung, O., Ozturk, M. A., & Kozub, F. (2004). Physical activity and social engagement patterns during physical education of youth with visual impairments: Patterns during physical education of youth with visual impairments. *RE:view*, 36, 39–48.
- Jackson, E. L. (1997). In the eye of the beholder: A comment on Samdahl & Jekubovich (1997), "A critique of leisure constraints: Comparative analyses and understandings." *Journal of Leisure Research*, 29, 458–468.
- Jackson, E. L., Crawford, D. W., & Godbey, G. (1993). Negotiation of leisure constraints. *Leisure Sciences*, 15, 1–12.
- Kay, T., & Jackson, G. (1991). Leisure despite constraint: The impact of leisure constraints on leisure participation. *Journal of Leisure Research*, 23, 301–313.
- Kozub, F. M., & Oh, H.-K. (2004). An exploratory study of physical activity levels in children and adolescents with visual impairments. *Clinical Kinesiology*, 58, 1–7.
- Kurtze, N., Ranqul, V., & Hustvedt, B. E. (2008). Reliability and validity of the International Physical Activity Questionnaire in the Nord-Trøndelag health study (HUNT) population of men. *BMC Medical Research Methodology*, 8, 63. doi:10.1186/1471-2288-8-63
- Lieberman, L. J., Byrne, H., Mattern, C. O., Watt, C. A., & Fernandez-Vivo, M. (2010). Health-related fitness of youths with visual impairments. *Journal of Visual Impairment & Blindness*, 104, 349–359.
- Lieberman, L. J., & McHugh, B. E. (2001). Health-related fitness of children with visual impairments and blindness. *Journal of Visual Impairment & Blindness*, 95, 272–286.
- Longmuir, P. E., & Bar-Or, O. (2000). Factors influencing the physical activity levels of youths with physical and sensory disabilities. *Adapted Physical Activity Quarterly*, 17, 40–53.
- Loucks-Atkinson, A., & Mannell, R. C. (2006). Role of self-efficacy in the constraint negotiation process: The case of individuals with fibromyalgia syndrome. *Leisure Sciences*, 29, 19–36.
- Marla Runyan. (n.d.). In *Wikipedia*. Retrieved from [http://en.wikipedia.org/wiki/Marla\\_Runyan](http://en.wikipedia.org/wiki/Marla_Runyan)
- Oh, H.-K., Ozturk, M.A., & Kozub, F. (2004). Physical activity and social engagement patterns during physical education of youth with visual impairments. *RE:view*, 36, 39–48.
- Prince, S. A., Adamo, K. B., Hamel, M. E., Hardt, J., Gorber, S. C., & Tremblay, M. (2008). A comparison of direct versus self report measures for assessing physical activity in adults: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, 5, 56–79.
- Ray, C., Horvat, M., Williams, M., & Blasch, B. (2007). Kinetic movement analysis in adults with vision loss, *Adapted Physical Quarterly*, 24, 209–217.
- Son, J. S., Kerstetter, D. L., & Mowen, A. J. (2008). Do age and gender matter in the constraint negotiation of physically active leisure? *Journal of Leisure Research*, 40, 267–289.
- Stanis, W., Sonja, A., Schneider, I. E., & Russell, K. C. (2009). Leisure time physical activity of park visitors: Retesting constraint models in adoption and maintenance stages. *Leisure Sciences*, 31, 287–304.
- Stanley, D., & Freysinger, V. J. (1995). The impact of age, health, and gender on the frequency of older adults' leisure activity participation: A longitudinal study. *Activities, Adaptation and Aging*, 19, 31–42.
- Statistics Canada. (1995). *National Population Health Survey public use microdata documentation*. Ottawa, ON: Ministry of Industry.
- Tsai, E. H.-L., & Coleman, D. J. (2009). The influence of constraints and self-efficacies on participation in regular active recreation. *Leisure Sciences*, 31, 364–383.
- World Health Organization. (2003). *Physical activity*. Retrieved from [http://www.who.int/topics/physical\\_activity](http://www.who.int/topics/physical_activity)



# Scoping Review: Product Selection Considerations for Individuals with Low Vision

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## Abstract

A scoping review of the literature was conducted on published works, over a 25-year span, to gain a perspective on what the study participants with low vision deemed to be important during the selection of assistive technology and mainstream products. A thematic analysis of the relevant articles suggested that the visual attributes of products, access to information, training, associated meaning, and the performance of activities may be important product-selection considerations by persons with low vision. This perspective, obtained from the literature, will inform and provide directions to subsequent qualitative and quantitative studies.

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Keywords: assistive technology, mainstream, commercial, consumers

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## Introduction

An assistive technology device may be defined as “any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain or improve functional capabilities of individuals with disabilities” (Assistive Technology Act, 2004). When selected, accepted, and used appropriately, assistive technology devices and commercial or mainstream products have the potential to facilitate meaningful activities that may increase the productivity, independence, self-confidence, and overall quality

of the life and health of persons with vision loss (Day, Jutai, Woolrich, & Strong, 2001; Goodrich, 2003; Inge, 2006; Sperazza, 2001; Stelmack, Rosenbloom, Brenne-man, & Stelmack, 2003). Unfortunately, many assistive technology devices are abandoned shortly after they are obtained, often within several months of purchase (Strong, Jutai, Bevers, Hartley, & Plotkin, 2003). The abandonment of commercial products by persons with disabilities is less clear. More attention is needed to include consumers with low vision in the development of criteria to support consumer-based product selection. Currently, there is a limited synthesis on what is known in the literature about the selection of products from the perspectives of participants with low vision that may be trans-

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lated into the development of a product-selection instrument to assist consumers with low vision.

A better understanding of the extant product-selection concepts specifically expressed by study participants with low vision was achieved through the use of a scoping review of the literature. A scoping review provides a comprehensive synthesis and coverage (breadth) of the available literature (Arksey & O'Malley, 2005). Compared to a systematic review, a scoping review focuses on research findings, not on the means to obtain them (e.g., through narrowly defined quality assessments), thus allowing for the inclusion and consideration of a variety of studies to inform the state of the art (Lambert, 2006; Weeks & Strudsholm, 2008). The use of a scoping review of the literature was well suited for the identification of extant concepts that participants with low vision may have identified in their decision to select, use, or abandon assistive technology devices or some commercial products. The methodological framework for a scoping review offered by Arksey and O'Malley (2005, p. 22) included five stages that were used in this review: Stage 1: identify the research question; Stage 2: identify relevant studies; Stage 3: select the studies; Stage 4: chart the data; and Stage 5: collate, summarize, and report the results (e.g., through a thematic analysis).

## Stages of a Scoping Review

### Stage 1: Identify the Research Question

The research question for the scoping review was as follows: What key concepts or factors have study participants with low vision expressed as being important during the selection, usage, or abandonment of assistive technology devices or products? The first point to note about the research question is that it prompted the selection of studies that were principally qualitative,

which was especially amenable to a scoping review as opposed to a systematic review (Davis, Drey, & Gould, 2009). To gain a better understanding of the selection of concepts and to inform the development of future instruments, it was important to err on the side of including more content (breadth), rather than less. Second, the scope of the search was widened to include not only studies that directly asked questions related to the selection of low vision products, but also those that examined usage as abandonment. Two key rationales for this decision were that only a small number of studies have focused on the selection of low vision products and that several factors for usage and abandonment have been theorized to influence the selection of assistive technology devices (Battivia & Hammer, 1990; Cook & Polgar, 2008; Reimer-Reiss & Wacker, 2000).

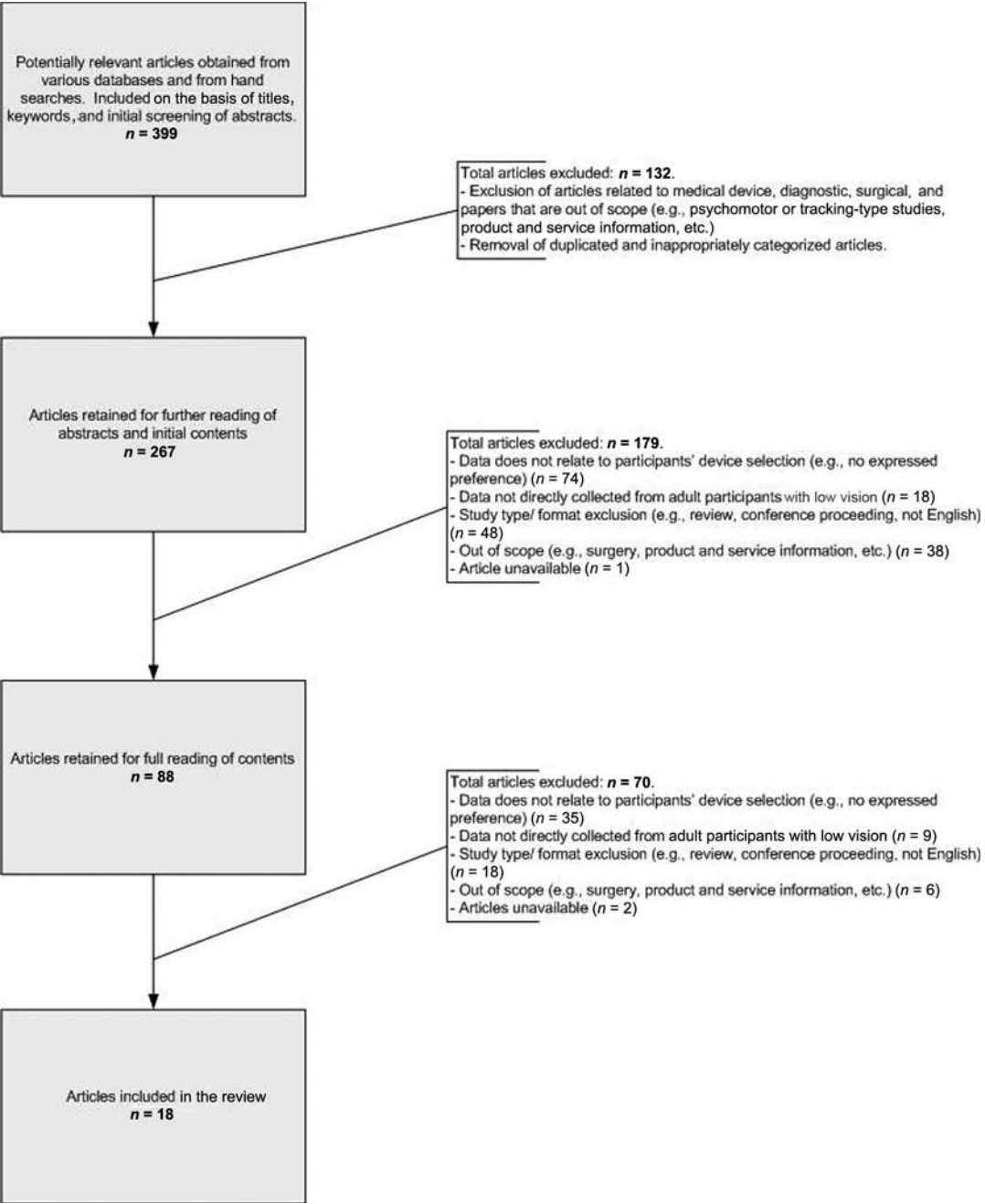
### Stage 2: Identify Relevant Studies

Eight databases were searched: Abledata, CINAHL, Cochrane Review, EMBASE, Psychinfo, PubMed, SCOPUS, and Socindex. The following combinations of keywords were used in the search: low vision, visual impairment; adaptive technology, assistive technology, technical aid, technical device, aid, device, and technology. The search parameters, which were limited by context and time (search period), consistent with scoping review methods (Arksey & O'Malley, 2005), included English, adults (aged 18 and older), between 1984 to 2009 (a 25-year span), and human (Arksey & O'Malley, 2005). The reasons for these parameters were to include all articles that the primary investigator could analyze and to reflect a period of growth in the recognized usage of assistive technology devices (Cornman, Freedman, & Agree, 2005; National Institute on Disability and Rehabilitation Research, 2006). Hand searches of relevant journals were also conducted.

### Stage 3: Select the Studies

Articles were included in the study in accordance with the fit and relevance to the re-

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**Figure 1.** A flow summary of the process taken to include relevant articles for the purpose of this scoping review.

search question (Arksey & O'Malley, 2005). Thus, two key criteria for the inclusion of an article in this review were that the data presented were collected directly from adult participants with low vision (aged 18 and older) and that the data related to factors or concepts that may affect whether a person selected a device or not (e.g., expressed

preference). See Figure 1 for a summary of how the articles were selected in the current review. Articles that did not provide insights into factors or data that relate to the selection, usage, or abandonment of devices were excluded, as were articles that presented data that were not directly collected from participants with low vision, such as

opinions and editorials. Systematic reviews were excluded, but they were reviewed for possible references (e.g., Jutai, Strong, & Russell-Minda, 2009; Virgili & Acosta, 2010; Virgili & Rubin, 2006; Wolffsohn & Peterson, 2003). Books and conference proceedings that did not provide sufficient information for the interpretation of the selection of products and related factors or concepts were excluded. In addition, articles related to medical devices, diagnoses, or surgical issues were excluded. The initial search resulted in 399 articles. 267 of which were reviewed further (reading of abstracts). Eighty-eight of the articles were kept for full reading, and 18 of them were included as part of the review.

### Stage 4: Chart the Data

A sample summary of the articles that were included in this review is presented in Table 1. The following headings were used:

- study and purpose: authors, year of the study, purpose of the study.
- research design and participants: type of study design; type of method; number, mean age, gender, and visual disability or acuity of the participants (if stated); otherwise assume low vision.
- device examined and context.
- relevant findings on the selection, usage, or abandonment of devices.

Information about the participants, the activity performed in particular contexts, and the device under examination was included if possible (Cook & Polgar, 2008). For ease of access, the studies were listed in alphabetical order.

### Stage 5: Collate, Summarize, and Report the Results

Eleven of the 18 studies that were included were qualitative, using focus groups, interviews, and related qualitative techniques. The remaining studies may be broadly classified as quantitative or mixed methods, using different permutations of survey designs and objective measures. It is important to

note that studies were excluded if only objective measures were used, such as reading rate and time to complete tasks, without a report of the subjective assessment of the performance from the participants.

For the purpose of collating, summarizing, and reporting concepts that related to the selection, usage, and abandonment of low vision products, a thematic analysis of the selected article summaries (see Table 1 for samples) was conducted to provide a narrative understanding. Thematic labels and statements were generated iteratively through the constant comparison of codes, groups of codes, notes, and the actual articles included in the review. The first author collaborated with the second and third authors to confirm the themes that were identified. Overall, five themes emerged and are summarized next.

#### Theme 1: Visual Attributes

Visual attributes refers to a product's function or features that allow persons with low vision to use their residual vision to conduct meaningful activities. Several visual attributes of the products were deemed important to consider. First, magnification strength, or the ability to have or adjust to the magnification that is appropriate for the user, seems to be an important aspect in contributing to the selection, usage, and abandonment of low vision products (Culham, Chabra, & Rubin, 2009; Lowe & Rubinstein, 2000; Mann, Goodall, Justiss, & Tomita, 2002; Okada & Kume, 1999; Stone, Mann, Mann, & Hurren, 1997; Wagner, Vanderheiden, & Sesto, 2006). A second important visual attribute of a product is its ability to provide good contrast (Wagner et al., 2006). In the summary of the survey to evaluate closed-circuit televisions (CCTVs), Okada & Kume (1999) suggested that a clear monochrome reverse-image and color image or display were relevant to the factor of contrast. Furthermore, appropriate lighting may be important to bring out good contrast (Stone et al., 1997). Although not mentioned as often as magnification or contrast

Table 1. Selection, Usage, and Abandonment of Low Vision Devices

Study and Purpose	Research Design and Participants	Device Examined and Contexts	Sample Findings on Selection, Usage, or Abandonment
<b>Becker, Wahl, Schilling, &amp; Burneddi (2005)</b> Exploring the role of control beliefs in the use of assistive technology devices (ATDs)	* Cross-sectional and repeated measure	* Visual aids (not including mobility or hearing aids)	* Use of technology is predicted by different things at different times (i.e., at T1, T2)
	* Measures: ATD use and control, theory-related variables; At T1, T2.	* Contexts: participants' use of devices in their everyday lives	
	* N = 71 (mean age = 79.5; 26 males, 64 females with ARMD)		
<b>Boulton (1989)</b> Reporting on clinical evaluation of several ATDs	* Clinical evaluation of equipment by participants who have low vision or are blind	* Closed-circuit television (CCTV)	* Three adults thought that the CCTV would increase their work capabilities
	* N = 17 (age: 21 to 42)	* Keynote (screen reader), talking word processor, Vista (electronic screen magnifier), VTS reporter (portable scan-read machine)	* Four other adults already had CCTVs for work use
	* N = 8 (age: 9 to 20)	* Context: clinical	* Three homemakers found the CCTVs useful for recreational reading
<b>Buning &amp; Hanzlik (1993)</b> Explore adaptive computer use by a person with a visual impairment	* Single-subject research	* Mac computer, built-in screen enlargement, screen reader	* Few participants liked the VTS reporter for portability
	* Quantitative measure for various types of reading: Qualitative and quantitative: Occupational Performance History Interview (OPHI)	* Context: campus apartment	* One young adult was able to use the Keynote right away
	* A 31-year-old female, legally blind since 19 (acute macular degeneration)		* One adult found the Keynote invaluable for accessing information
<b>Copolillo &amp; Teitelman (2005)</b> Describes individual factors affecting the likelihood to seek, acquire, and use a low-vision ATD (LVAD)	* Applied ethnography (interview), grounded theory (focus groups)	* LVAD	* The participant attributed changes in her roles, role balance, and interest enactment to her increased independence, empowerment, and efficient use of time as a result of her adapted computer system
	* N = 15 (mean age = 75.7; 10 M; 5 women)		* Thematic analysis results: (1) Experiences and characteristics leading to successful decision making about the use of a LVAD; (2) challenges to successful decision making; (3) adjustment to low vision included negative emotional aspects that extended beyond the decision to use a device to the use of other mechanisms to cope with lifestyle changes
	* Visual acuity between 20/70 and 20/400 in the better eye	* Contexts: study took place in a clinical setting and in the home	* Facilitators: Training and choice; trial—ability and assistance from a professional; device that provides substantial solutions to serious problems
			* Barriers: Cumbersome; requires an unreasonable amount of energy to use; limited solutions to functional loss discarded

Note: IV = independent variables, DV = dependent variables. (cont.)



Table 1. (Cont.)

Study and Purpose	Research Design and Participants	Device Examined and Contexts	Sample Findings on Selection, Usage, or Abandonment
<b>Cruden (2002)</b> Explore and report on challenges of job retention after vision loss	<ul style="list-style-type: none"> <li>* Collective case study approach (telephone interview with the participant and others, such as the employer and counselor; specifics not reported)</li> <li>* <math>N = 10</math> participants who were blind or had low vision (age not reported; 7 men and 3 women)</li> </ul>	<ul style="list-style-type: none"> <li>* Nine of 10 used computers with assistive technology</li> <li>* Mobility aids</li> <li>* Context considered is work</li> </ul>	<ul style="list-style-type: none"> <li>* Mobility aid usage for transportation</li> <li>* One participant: use of a cane was like "coming out of the closet"</li> <li>* Impact of computer technology on job retention throughout the case studies (positive); use of computer technology also a source of stress: delay obtaining equipment, fear of not enough time to learn, fear of incompatibility</li> </ul>
<b>Culham, Chabra, &amp; Rubin (2009)</b> Evaluate an electronic vision-enhancement system and correlate opinions with performance	<ul style="list-style-type: none"> <li>* Mixed methods</li> <li>* <math>N = 10</math> (mean age = 41.8, ARMD)</li> <li>* <math>N = 10</math> (early-onset MD; mean age = 73.5)</li> </ul>	<ul style="list-style-type: none"> <li>* Head-mounted devices</li> <li>* Contexts: study took place in the lab and home</li> </ul>	<ul style="list-style-type: none"> <li>* One-third said no instructions were needed</li> <li>* Ongoing support and training may be useful</li> <li>* Important features: magnification, comfort (weight not size), but only magnification was significantly predictive of the ratings</li> <li>* Newly diagnosed responded more positively</li> <li>* "Knowing what performance aspects influence user opinion" may help curb abandonment</li> <li>* Threshold effect: "good enough" performance</li> </ul>
<b>de Jonge, Rodger, &amp; Fitzgibbon (2001)</b> Describe and understand factors perceived as important in integrating technology in the workplace (and barriers)	<ul style="list-style-type: none"> <li>* Qualitative (thematic analysis)</li> <li>* <math>N = 15</math> with a disability (age range 20 to 60; 4 with a visual impairment)</li> <li>* <math>N = 8</math> employers</li> <li>* <math>N = 4</math> coworkers</li> <li>* Four focus groups</li> </ul>	<ul style="list-style-type: none"> <li>* Braille printer, text-to-speech engine</li> <li>* Contexts: comments based on the workplace</li> </ul>	<ul style="list-style-type: none"> <li>* Only a few results were vision specific</li> <li>* Text to speech required extra concentration, creating mental strain for one participant</li> <li>* One participant was conscious of her braille printer being distracting to others in the work environment</li> </ul>
<b>Gerber (2003)</b> Benefits of and barriers to computer use	<ul style="list-style-type: none"> <li>* Total <math>N = 41</math> (age not reported; 85% with some college or beyond; 75% employed)</li> <li>* Blind or with low vision</li> </ul>	<ul style="list-style-type: none"> <li>* Computers</li> <li>* 35 of 41 used at work; other contexts: library, school, home, shopping malls</li> </ul>	<p>Benefits: Independence; personal meaning; self-esteem; freedom, liberty, flexibility in access; expression (better writer); connecting with others and the world</p> <p>Barriers: Lack of training, cost for training, accessibility, technical jargon, dependence on sighted persons, change to a graphic from a text-based system, low quality, low selection</p>

(cont.)

Table 1. (Cont.)

Study and Purpose	Research Design and Participants	Device Examined and Contexts	Sample Findings on Selection, Usage, or Abandonment
<b>Lines &amp; Hone (2006)</b> Evaluation of speech output in interactive domestic alarm systems to support older adults	* Mixed three-factorial experimental design and feedback (IV: environmental, speech source and gender; DV: participant evaluations) <i>N</i> = 32 adults aged 65 or older (15 men, 17 women)	* Speech output from a laptop computer.  * Context: laboratory	* Natural speech significantly more "pleasant," "intelligent," "less boring," "less irritating," and more "natural"  * Natural male speech significantly clearer than the synthetic male speech and natural female speech * Synthetic speech evaluated as more natural in noise conditions
<b>Lowe &amp; Rubinstein (2000)</b> Surveying success and failures in the use of distance telescopes	* Retrospective survey of patients with low vision  * Questionnaire 1 (Q1) <i>N</i> = 87; (Q2) <i>N</i> = 74 (age range: 9 to 91, mostly adults aged 19 and older)	* Distance telescope  * Contexts: Q2 reports usage of distance telescope 6 indoors and 11 outside the home	* Q1: Ease and frequency of use are significantly associated  * Q2: Some reasons for disuse: too heavy, too unsteady, focusing, cannot see, feels unsafe, headaches, do not understand, moving objects, limits peripheral vision
<b>Mann, Goodall, Justiss, &amp; Tomita (2002)</b> Report on the use of and dissatisfaction with ATDs in a sample of frail elderly persons	* Survey within a longitudinal study of the coping strategies of frail elderly persons (e.g., aged 60 and older) with disabilities  * <i>N</i> = 1,056	* Canes, magnifiers, and other technology  * Context: face-to-face interviews in the participants' homes	* Owned but not used: canes, 32.4%; magnifiers, 26.5%; eyeglasses (6%)  * Reasons for nonuse or dissatisfaction with magnifiers: not strong, too small, do not help, vision has deteriorated, print blurry or distorted, light too strong, too much glare, can't focus, nauseated, difficult to hold, field of view very small, need light, not needed, scratched, too slow to use
<b>Mann, Hurren, Karuza, &amp; Bentley (1993)</b> Examine the use of and need for ATDs	* Intensive interviews: <i>N</i> = 30 (mean age = 72.5) * Two with fair vision and 20 with poor vision, 8 totally blind	* Visual or physical disability: tactile, hearing, cognitive, and other devices * Context: participants' homes	* Example problems: glare, fear of victimization, embarrassment, stigma * Many participants did not have the latest information
<b>Okada &amp; Kume (1999)</b> CCTV user survey and then prototyping and testing	* Survey (no information provided on the type of survey) of current CCTV users  * <i>N</i> = 115 (mean age = 33.5; 75 men, 40 women)	* CCTVs (including portable)  * Contexts: <i>N</i> = 89 responded to context question (office = 26, school = 3, home = 60)	* Reasons for selecting: Clear monochrome reverse image ( <i>n</i> = 44), high magnification ( <i>n</i> = 40), easy manipulation of control panel ( <i>n</i> = 29), color image ( <i>n</i> = 24), low price * Major demand factors for improvement: small size, lightweight ( <i>n</i> = 40), large movement of try table ( <i>n</i> = 10)
<b>Ryan, Anas, Beamer, &amp; Bajorek (2003)</b> Assess the impact of vision loss on reading for leisure and instrumental activities of daily living	* In-depth semistructured interviews  * Moderate and severe vision loss * <i>N</i> = 26 (mean age = 78.5; 18 women and 8 men)	* Low- and high-tech reading aids  * Context used: various	* Reading aids only part of the compensatory options; computer use pros and cons  * Personal factors: effort, frustration using * Guidance in selection is important

(cont.)

Table 1. (Cont.)

Study and Purpose	Research Design and Participants	Device Examined and Contexts	Sample Findings on Selection, Usage, or Abandonment
<b>Stone, Mann, Mann, &amp; Hurren (1997)</b> Identify factors related to dissatisfaction with the use of magnifiers	* Four steps: home interview, try at clinic, brought to home and shown, telephone follow-up	* Magnifiers	* Case study 1: Nonuse because too bulky. Likes new magnifier because it provides a "sharp" image and better field; magnifier and light combination useful; effective in restaurants and fits easily in a purse
	* Case studies	* Contexts: trial at clinic and home	* Case study 2: Felt that the power not strong enough; liked the new magnifier, light not essential, ability to read independently
	* N = 15 (mean age = 78.5; 14 with poor vision, 1 with fair vision)		
<b>Wagner, Vanderheiden, &amp; Sesto (2006)</b> To examine enlargement features on cell phones	* Mixed methods	* Cell phone with enlargement feature	* Quantitative: Significant improvement in dialing accuracy
	* N = 8 (mean age = 61; 6 women, 2 men)	* Context: unspecified	* Qualitative: Enlargement feature was "nice to have" for some operations
			* Additional comments on shape, tactile feedback, contrast, layout of buttons, difficulty in pressing keys
<b>Williamson, Albrecht, Schauder, &amp; Bow (2001)</b> Attitudes and experiences of persons with visual impairments and professionals toward accessing information on the Internet	* Focus groups and interviews	* Access technology, such as JAWS and ZoomText.	* Question: Why not use?
	* N = 31 (age range = 20 to 79; 20 legally blind)	* Context: considered use on the Internet.	* Availability of other source of information, cost, fear of technology, difficulties using adaptive equipment and software, difficulties obtaining training
<b>Wolffe, Candela, &amp; Johnson (2003)</b> Reporting on discussions regarding assistive technology training issues	* Focus groups (8 consumer focus groups, 4 trainers), inductive data analysis procedure, thematic analysis	* ATD for visual impairment and mainstream technology	* Additional factors: support from disability organizations and personal networks of support
	* N = 55 legally blind (ages not reported)	* Context: focus group settings across the United States	* Three themes: adequacy of training, critical needs for assistive technology training, work-related challenges f the participants during and after training

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in the literature, other visual attributes of the product, such as good clarity (Copolillo & Teitelman, 2005), low glare (Mann et al., 2002), and appropriate sharpness (Stone et al., 1997), also appeared in the data in this review.

### Theme 2: Access to Information

Access to information refers to access to electronic or printed material to learn about the products or services. Two separate factors or criteria are necessary for successful access to information. The first factor refers to the accessibility and availability of information about a product or a service, which may be important in deciding whether to obtain a product or how to set it up (Copolillo & Teitelman, 2005; Gerber, 2003; Mann, Hurren, Karuza, & Bentley, 1993; Ryan, Anas, Beamer, & Bajorek, 2003; Williamson, Albrecht, Schauder, & Bow, 2001). Second, access to information may require the use of products (e.g., a magnifier, CCTV, computer, and the Internet) to obtain or read the information (Boulton, 1989; Gerber, 2003). This theme does not include training, which is the next theme discussed.

### Theme 3: Training

Training refers to the various degrees of instruction or hands-on training or both that a person with low vision needs to use a product. One determinant of obtaining the necessary training is the availability of training (Copolillo & Teitelman, 2005). The lack of available training (e.g., long waiting lists or no training facility) and the high cost of training were considered barriers to the use of low vision products (Gerber, 2003; Ryan et al., 2003; Williamson et al., 2001). Wolffe, Candela, and Johnson (2003) reported on a comprehensive focus group study (8 consumer focus groups,  $N = 55$  persons who were legally blind), which looked at issues that are related to training in low vision products (e.g., computers, mainstream software, electronic screen readers, magnifiers, and scanners). A thematic analysis revealed three main themes from the focus

groups: (1) adequacy of training (positive, negative, or neutral), (2) critical needs for training (hardware and software issues, core curriculum concerns, life or employability skills, and gaining access to training and support services), and (3) work-related challenges of the participants during and after training (e.g., unmet equipment and software needs, difficulty finding jobs, physical limitations from diminished vision, the lack of training needed to fulfill their job responsibilities). In addition to learning about a low vision product or how to use a product through product information, the ability to try out a product (Rogers, 2003) is also important. This finding was supported by two studies (Copolillo & Teitelman, 2005; Culham et al., 2009).

### Theme 4: Meaning

The fourth theme can be broadly referred to as the meaning associated by the person with the low vision product. Some low vision products may be a source of empowerment to the person who selects and uses them, as well as a support for personal independence (Buning & Hanzlik, 1993). For example, Gerber (2003) concluded, from qualitative data from a focus group, that the use of computers may benefit the individual by supporting independence, personal meaning (being employable), increasing self-esteem, and promoting freedom and liberty. Alternately, it is important to note that some persons with low vision still feel they are stigmatized by the use of the white cane (Crudden, 2002; Spencer, 1998). Mann et al. (1993) found that some participants feared being victimized, embarrassed, and stigmatized by using the white cane. The ability to be “inconspicuous” or to “fit in” when using a low vision product may be important for some people with low vision for safety and aesthetic reasons (Mann et al., 1993; Okada & Kume, 1999; Williamson et al., 2001).

### Theme 5: Performance

Finally, the low vision product’s ability to support the performance of activities may

be the last key theme extracted from the review. Several studies have pointed to the expressed need by participants to be productive and to maintain or increase their work capabilities (Boulton, 1989; Buning & Hanzlik, 1993; Culham et al., 2009). The functions and features of the low vision product, including whether it is portable, have been identified by numerous studies as being important during the selection and use processes (Boulton, 1989; Copolillo & Teitelman, 2005; Okada & Kume, 1999; Stone et al., 1997).

## Discussion

The thematic analysis of the 18 studies suggests that visual attributes, access to information, training, meaning, and performance may be important considerations in the selection, usage, and abandonment of products. A comparison of the concepts identified through this scoping review to the selection concepts found in the general literature on assistive technology devices revealed that the current review highlighted content that is specific to low vision through the themes of visual attributes and access to information. For instance, the visual attributes of a product, such as its magnification strength, contrast, brightness, clarity, lack of glare, and sharpness, are especially relevant to users with low vision. In addition, access to information through alternative documentation formats and the support of devices has been underconsidered and is especially important for persons with low vision in the performance of everyday meaningful activities (Fok & Sutarno, 2003).

From a practice and research standpoint, there is merit for individuals with low vision and other stakeholders to consider many of these concepts explicitly, during the design and selection of products, through the use of instruments. For example, upon item generation and psychometrics testing, these additional considerations may add to the cross-disability selection tools or design checklists for assistive technology devices (Scherer, 1998) to aid individuals with low

vision to select products. Furthermore, since these attributes were developed on the basis of the “voices” of participants with low vision, they may be especially relevant to individuals with low vision as they, for example, evaluate the fit of assistive technology devices to meet their personal needs (Wessels, 2004).

The three remaining themes are generally congruent with selection factors that have been deemed important in the literature on assistive technology devices and occupational therapy (Cook & Polgar, 2008; Scherer, Jutai, Fuhrer, Demers, & DeRuyter, 2007). A subtle but important point that needs to be emphasized is that stakeholders must be mindful that selection of a product goes beyond an evaluation of its function and features. For example, the meaning that a person ascribes to a device, above and beyond how it functions, has been well discussed in the literature as an important factor in gauging whether someone will ultimately accept or reject the device (Hocking, 1999; King, 1999; Pape, Kim, & Weiner, 2002; Spencer, 1998). Similarly, the theme of performance highlights the point that what ultimately matters is what the individual with low vision may “do” with the device (i.e., the performance of activities).

Beyond the identification of key themes that may aid in the development of tools for the selection of low vision products, the current scoping review identified some gaps in the literature and highlighted the need for further primary research to inform practice. First, some studies did not provide the types and range of assistive technology devices that were examined by the participants. Therefore, some factors may not be applicable, depending on the type of assistive technology device that was discussed. More work in understanding what makes an individual with low vision select a specific assistive technology device over another for particular functioning or performance of an activity in context would be useful (e.g., the use of a nonelectronic handheld mag-



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nifier verses an electronic handheld magnifier for grocery shopping). On a related note, studies in this area may be strengthened by a better understanding of the types of technologies that were being used by the participants, the participants' level of comfort with them, and the participants' predispositions to using other technologies (Scherer, 1998).

Second, it is unclear whether the age of individuals with low vision or the age of onset of their low vision or both may affect the selection of products, since many studies in this area have focused on older adults. Research to gain a better understanding of whether these two factors may have a measurable effect on the types of considerations that individuals with low vision may have during product selection may be important to ensure the proper fit of devices, to reduce the abandonment of devices, and to inform the design of products.

Third, the use of commercial products, especially in the contemporary information-driven milieu, for the performance of meaningful activities is paramount for persons with low vision (Greenfield, 2006; Fok, Polgar, Shaw, Luke, & Mandich, 2009). It is not acceptable to omit commercial products, especially information and communication technology that may be useful for persons with low vision to perform activities (Greenfield, 2006; Fok et al., 2009). For instance, with built-in accessibility features becoming popular in commercial products (e.g., screen magnifiers and screen readers on smartphones), consumers, service providers, researchers, and other stakeholders will need to be able to evaluate critically the impact of nontraditional assistive technology devices on functioning and the performance of activities. Six of the 18 studies in the scoping review considered mainstream commercial products that may be used by persons with low vision (Buning & Hanzlik, 1993; Crudden, 2002; Gerber, 2003; Lines & Hone, 2006; Wagner et al. (2006); Wolffe et al., 2003). On the basis of these findings, there seems to be some focus on the use of

commercial products by individuals with low vision. Continued and expanded work in this area will be essential.

There were several limitations to the study that should be highlighted. The findings from the scoping review point to the need for future primary research that focuses on the selection of products by participants with low vision. A key limitation of this scoping review is that it identified only a small number of studies that specifically focused on the selection of products. More research with questions directly related to the selection of products should be conducted. The concepts of usage and abandonment may be more reactive, and further understanding of the selection of products is necessary to facilitate considerations and recommendations of the most suitable products in the first place. Furthermore, while it has been theorized that the concepts related to usage and abandonment may likely be related to selection, this assertion needs to be validated with participants with low vision (Bativia & Hammer, 1990; Cook & Polgar, 2008; Reimer-Reiss & Wacker, 2000).

The second limitation of the study is that although a consistent template was used to chart the data in Stage 4, not all the articles included all the information that the authors of this review deemed essential to consider. For example, because of the nature of working with small samples, some authors of qualitative studies may decide to omit certain specific details of participants (e.g., age and geographic location) to ensure confidentiality and anonymity. Other authors may prefer to report using different forms of descriptive data (e.g., age range, mean age, and cutoff age). Also worthy to note is that there was a discrepancy among the studies in the reporting of the visual condition of the participants. The manner of reporting used in the studies included medical diagnoses (e.g., age-related macular degeneration, early-onset macular degeneration); visual acuity; or categories of vision loss, such as severely or moderately

visually impaired, legally blind, visually impaired, or low vision. The inconsistency in the reporting of the participants' visual conditions and other data made it difficult to compare the results of the various studies.

## Conclusions

A scoping review of the literature for the breadth of considerations related to the selection of products from research participants with low vision revealed that few studies have looked at the issue of product selection directly. A thematic analysis of the 18 studies with data on the selection, usage, and abandonment of products by participants with low vision suggested that the themes of visual attributes, access to information, training, meaning, and performance were important. Thus, future primary research that is specifically focused on the selection of assistive technology devices (including commercial products) with participants with low vision is necessary to validate the findings of this scoping review. To facilitate the better transfer of knowledge, when possible, future research should also present more information about the participants with low vision, the activities they perform, the context in which they perform the activities, and specific products they use in the activities (Cook & Polgar, 2008).

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## References

Assistive Technology Act of 1998, as amended. P.L. No.108-364. §3, 118 Stat. 1707 2004.

Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, 8, 19–32.

Batavia, A. I., & Hammer, G. S. (1990). Toward the development of consumer-based criteria for the evaluation of assistive devices. *Journal of Rehabilitation Research and Development*, 27, 425–436.

Becker, S., Wahl, H., Schilling, O., & Burmedi, D. (2005). Assistive device use in visually impaired older adults: Role of control beliefs. *The Gerontologist*, 45(6), 739–746.

Boulton, L. M. (1989). A clinical evaluation of equipment which allows the partially sighted and blind to access computer-based information. *Australian and New Zealand Journal of Ophthalmology*, 17(1), 87–93.

Buning, M. E., & Hanzlik, J. R. (1993). Adaptive computer use for a person with visual impairment. *American Journal of Occupational Therapy*, 47, 998–1008.

Cook, A. M., & Polgar, J. M. (2008). *Cook & Hussey's assistive technologies: Principles and practice* (3rd ed.). St. Louis, MO: Mosby Elsevier.

Copolillo, A., & Teitelman, J. L. (2005). Acquisition and integration of low vision assistive devices: Understanding the decision-making process of older adults with low vision. *American Journal of Occupational Therapy*, 59, 305–313.

Cornman, J. C., Freedman, V. A., & Agree, E. M. (2005). Measurement of assistive device use: Implications for estimates of device use and disability in late life. *The Gerontologist*, 45, 347–358.

Crudden, A. (2002). Employment after vision loss: Results of a collective case. *Journal of Visual Impairment & Blindness*, 96, 615–622.

Culham, L. E., Chabra, A., & Rubin, G. S. (2009). Users' subjective evaluation of electronic vision enhancement systems. *Ophthalmic & Physiological Optics*, 29, 138–149.

Davis, K., Drey, N., & Gould, D. (2009). What are scoping studies? A review of the nursing literature. *International Journal of Nursing Studies*, 46, 1386–1400.

Day, H., Jutai, J. W., Woolrich, W., & Strong, G. (2001). The stability of impact of assistive devices. *Disability and Rehabilitation*, 23, 400–403.

## Technology Review

- de Jonge, D., Rodger, S., & Fitzgibbon, H. (2001). Putting technology to work: Users' perspective on integrating assistive technology into the workplace. *Work, 16*, 77–89.
- Fok, D., Polgar, J., Shaw, L., Luke, R., & Mandich, A. (2009). Cyberspace, real place: Thoughts on “doing” in contemporary occupations. *Journal of Occupational Science, 16*, 38–43.
- Fok, D., & Sutarno, C. (2003, October). Overcoming barriers: Workplace accommodations for people with vision impairment. In *Proceedings of the 34th Annual Conference of the Association of Canadian Ergonomists*, London, ON. Calgary, Alberta, Canada: Association of Canadian Ergonomists.
- Gerber, E. (2003). The benefits of and barriers to computer use for individuals who are visually impaired. *Journal of Visual Impairment & Blindness, 97*, 536–550.
- Goodrich, G. L. (2003). Available and emerging technologies for people with visual impairment. *Generations, 27*, 64–70.
- Greenfield, A. (2006). *Everyware: The dawning age of ubiquitous computing*. Berkeley, CA: New Riders.
- Hocking, C. (1999). Function or feelings: Factors in abandonment of assistive devices. *Technology and Disability, 11*, 3–11.
- Inge, K. J. (2006). Assistive technology as a workplace support. *Journal of Vocational Rehabilitation, 24*, 67–71.
- Jutai, J. W., Strong, G., & Russell-Minda, E. (2009). Effectiveness of assistive technologies for low vision rehabilitation: A systematic review. *Journal of Visual Impairment & Blindness, 103*, 210–222.
- King, T. W. (1999). *Assistive technology: Essential human factors*. Boston: Allyn & Bacon.
- Lambert, H. (2006). Accounting for EBM: Notions of evidence in medicine. *Social Science & Medicine, 62*, 2633–2645.
- Lines, L., & Hone, K. S. (2006). Multiple voices, multiple choices: Older adults' evaluation of speech output to support independent living. *Gerontechnology, 5*, 78–91.
- Lowe, J. B., & Rubinstein, M. P. (2000). Distance telescopes: A survey of user success. *Optometry and Vision Science, 77*, 260–269.
- Mann, W. C., Goodall, S., Justiss, M. D., & Tomita, M. (2002). Dissatisfaction and nonuse of assistive devices among frail elders. *Assistive Technology, 14*, 130–139.
- Mann, W. C., Hurren, D., Karuza, J., & Bentley, D. W. (1993). Needs of home-based older visually impaired persons for assistive devices. *Journal of Visual Impairment & Blindness, 87*, 106–110.
- National Institute on Disability and Rehabilitation Research. (2006). Notice of final long-range plan for fiscal years 2005–2009. *Federal Register, 71*(31), 8165–8200.
- Okada, S., & Kume, Y. (1999). CCTV user survey and prototypes based on the survey results. *Technology & Disability, 11*, 123–131.
- Pape, T., Kim, J., & Weiner, B. (2002). The shaping of individual meanings assigned to assistive technology: A review of personal factors. *Disability and Rehabilitation, 24*(1–3), 5–20.
- Reimer-Reiss, M., & Wacker, R. (2000). Factors associated with assistive technology discontinuance among individuals with disabilities. *Journal of Rehabilitation, 66*(3), 44–49.
- Rogers, E. M. (2003). *Diffusion of innovation* (5th ed.). New York: Free Press.
- Roulstone, A. (1998). *Enabling technology: Disabled people, work, and new technology*. Philadelphia: Open University Press.
- Ryan, E. B., Anas, A. P., Beamer, M., & Bajorek, S. (2003). Coping with age-related vision loss in everyday reading activities. *Educational Gerontology, 29*, 37–54.
- Scherer, M. (1998). *The matching person & technology (MPT) model manual* (rev. ed.). Webster, NY: Institute for Matching Person & Technology, Inc.
- Scherer, M., Jutai, J., Fuhrer, M., Demers, L., & DeRuyter, F. (2007). A framework for modeling the selection of assistive technology devices (ATDs). *Disability and Rehabilitation, 2*, 1–8.
- Spencer, J. C. (1998). Tools or baggage? Alternative meanings of assistive technology. In D. B. Gray, L. A. Quatrano, & M. L. Lieberman (Eds.), *Designing and using assistive technology: The human perspective* (pp. 89–97). Baltimore, MD: Paul H. Brookes.
- Sperazza, L. C. (2001). Rehabilitation options for patients with low vision. *Rehabilitation Nursing, 26*, 148–51.
- Stelmack, J. A., Rosenbloom, A. A., Brenne-man, C. S., & Stelmack, T. R. (2003). Patients'

- perceptions of the need for low vision devices. *Journal of Visual Impairment & Blindness*, 97, 521–535.
- Stone, J., Mann, W., Mann, J., & Hurren, D. (1997). Use of magnifiers by older persons with low vision. *Technology & Disability*, 6, 169–175.
- Strong, G., Jutai, J., Bevers, P., Hartley, M., & Plotkin, A. (2003). The psychosocial impact of closed-circuit television low vision aids. *Visual Impairment Research*, 5, 179–190.
- Virgili, G., & Acosta, R. (2010). Reading aids for adults with low vision. *Cochrane Database Systematic Review*, 5:CD003303.
- Virgili, G., & Rubin, G. (2006). Orientation and mobility training for adults with low vision. *Cochrane Database Systematic Review*, 3:CD003925.
- Wagner, J., Vanderheiden, G. C., & Sesto, M. E. (2006). Improving the usability of a mainstream cell phone for individuals with low vision. *Journal of Visual Impairment & Blindness*, 100, 687–692.
- Weeks, L., & Strudsholm, T. (2008). A scoping review of research on complementary and alternative medicine (CAM) and the mass media: Looking back, moving forward. *BMC Complementary & Alternative Medicine*. Retrieved from <http://www.biomedcentral.com/1472-6882/8/43>
- Wessels, R. (2004). *Ask the user. User perspective in the assessment of assistive technology*. Thesis, Maastricht University, Maastricht, the Netherlands.
- Williamson, K., Albrecht, A., Schauder, D., & Bow, A. (2001). Australian perspectives on the use of the Internet by people who are visually impaired and professionals who work with them. *Journal of Visual Impairment & Blindness*, 95, 690–701.
- Wolffe, K. E., Candela, T., & Johnson, G. (2003). Wired to work: A qualitative analysis of assistive technology training for people with visual impairments. *Journal of Visual Impairment & Blindness*, 97, 677–694.
- Wolffsohn, J. S., & Peterson, R. C. (2003). A review of current knowledge on electronic vision enhancement systems for the visually impaired. *Ophthalmic & Physiological Optics*, 23, 35–42.

# The Effectiveness of the Nemeth Code Tutorial for the BrailleNote: A Follow-up Study

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## Abstract

The researchers conducted a second, follow-up study to evaluate the immediate and longer-term effectiveness of a software tutorial that can be installed on the BrailleNote and used by students who are blind to learn the Nemeth Code of braille mathematics notation. Pretest to posttest growth scores on reading and writing mathematical symbols were obtained for the former (original) control group, and were compared to scores on the same pre- and posttests for the former (original) treatment group students. Results indicated that the control group students showed significant growth from the beginning of the school year to the conclusion of the school year after having been exposed to the Nemeth Code tutorial. Also, the analysis of the data emanating from the pretests and posttests completed by the treatment group students indicated that the tutorial's effects persisted one year after treatment.

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Key words: Nemeth Code, braille, mathematics, BrailleNote, students who are blind

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This report describes the results of a follow-up study on the effectiveness of the Nemeth Code tutorial for the BrailleNote. The results of the original study were published in a previous issue (Kapperman, Sticken, & Smith, 2011). The concept of an accessible Nemeth Code tutorial originated as a response to concerns about the low level of math achievement in the population of students who read braille, and the results of several studies that indicate that teach-

ers of such students are not trained adequately in the Nemeth Code, the braille code for mathematics notation (published in 1962 by Abraham Nemeth). Many teachers of students with visual impairments lack the necessary competence for teaching the Nemeth Code to their students; consequently, the students are unable to read or write braille math, requisite skills for the study and mastery of mathematics (Wittenstein, 1993; Kapperman, 1994; DeMario & Lian, 2000; DeMario, Lang, & Lian, 1998; Amato, 2002; Rosenblum & Amato, 2004). The tutorial was developed by the research-

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ers, in cooperation with software engineers employed by the manufacturer of the Braille-Note (Humanware Group), to give teachers of students who are blind an additional tool that they can use to help their students become more proficient in reading and writing the Nemeth Code.

The original study (Kapperman, Sticken, & Smith, 2011) used an experimental design in which 57 braille-reading students ranging in grade placement from the fifth to the eleventh grades were matched on three variables: (a) grade level, (b) level of achievement in mathematics, and (c) ethnicity. The teachers of the treatment group received copies of the tutorial to install on their students' BrailleNotes, along with instructions on operation of the program. The control group teachers were instructed to continue with the regular educational program that had been established for their students. Both groups of teachers administered Nemeth Code writing and reading pretests to their students during the first month of the 2007–2008 school year.

The treatment group teachers used the tutorial with their students during their regular instructional sessions, and provided monthly progress reports to the researchers. At the conclusion of the school year, both the treatment group teachers and control group teachers administered equivalent Nemeth Code writing and reading posttests. The results indicated that the students in the treatment group demonstrated significantly greater growth in scores compared to students in the control group. The entire report can be found in the Winter 2011 issue of *Insight* (Kapperman et al., 2011).

## Method

During the following school year, 2008–2009, the researchers carried out a follow-up study. The purpose of the study was twofold. First, we wanted to determine if the results of the first study could be replicated. Secondly, we wanted to evaluate the long term retention of the knowledge

gained by the treatment group the previous year.

## Participants

At the beginning of the second year, teachers for the former control group (hereafter “Group A”) were given copies of the software to install on their students' BrailleNotes, and the same instructional materials that were distributed to the former treatment group teachers (hereafter, “Group B”) at the beginning of the first year. The Group B teachers were instructed to continue with their students' regular educational program. They were encouraged to include the tutorial in the students' educational program wherever it might reasonably fit. At the beginning of the 2008–2009 school year, each group administered the same writing and reading pretests that had been given the previous year; these tests were administered again at the close of the 2008–2009 school year (refer to Table 1 for information on the study design and Table 2 for demographic characteristics). The total sample size ( $N = 41$ ) was reduced from the initial study ( $N = 57$ ). Attrition in year 2 occurred for several reasons: (1) some of the children who participated in year 1 chose not to participate; (2) some teachers changed positions, and the replacement teachers did not respond to requests for participation; and (3) some of the students were seniors in year 1, and thus had graduated by year 2.

## Instrumentation and Procedure

The instruments used in the present study consisted of two equivalent forms: (1) a writing test and (2) a reading test. Each instrument contained 75 items that reflected the content of the tutorial. In the writing test, students were asked to braille the Nemeth Code expressions with a brailewriter while their teachers read the expressions to them (e.g., “Write the fraction, two-thirds, in horizontal format using the regular fraction line for this type of fraction”). The students were instructed to braille as many of the items as possible, until they were no longer able to braille five items in a sequence. Once this

Table 1. Study Design

Group		Year 1			Year 2		
Group A	R	O <sub>1</sub>		O <sub>2</sub>	O <sub>3</sub>	X	O <sub>4</sub>
Group B	R	O <sub>1</sub>	X	O <sub>2</sub>	O <sub>3</sub>		O <sub>4</sub>

Note. R = random assignment, O = observation (math symbols reading/writing tests), X = Nemeth Code tutorial intervention.

point was reached, the teachers were instructed to terminate the writing test and commence with the reading test. Students were instructed to read as many of the symbols (items) as they were able from the reading test until they could no longer successfully read five symbols in a sequence. The entire test administration session was audio-recorded.

At the conclusion of the treatment period, equivalent forms of the writing and reading tests were administered as posttests, using procedures identical to those outlined above. To score the tests, three raters from the project staff independently evaluated test responses by judging the accuracy of the written responses and by listening to audio tapes of the students reading their responses on the reading evaluation instrument. Each item was scored as either correct or incorrect, based on each rater's independent evaluation of whether the student's written response matched the correct

response as indicated on the answer key (for the writing test) or whether the student's spoken response corresponded to the correctly keyed item. For the second-year data, rater consistency for the math reading test was 93% (pretest) and 91% (posttest), while for the math writing test it was 91% (pretest) and 92% (posttest). Where discrepancies in the raters' evaluation of an item occurred, the item score was recorded as the rating for the majority of the raters (i.e., the rating given by two of three raters).

For each student, a total score for the reading and writing tests was then computed as the sum of the correct responses to the items (refer to Table 3, Descriptive statistics for math reading test scores, and Table 4, Descriptive statistics for math writing test scores). Split-half reliability was strong for scores from the original (first-year) math reading test (.97 and .96 for the pre- and posttests, respectively), and also for

Table 2. Demographic Characteristics of Treatment and Control Groups

Characteristic	Group A	Group B
	Frequency (percent)	Frequency (percent)
Gender		
Male	11 (50.0%)	9 (47.4%)
Female	11 (50.0%)	10 (52.6%)
Total	22 (100.0%)	19 (100.0%)
Ethnicity		
Caucasian	17 (77.4%)	12 (63.2%)
Hispanic	3 (13.6%)	4 (21.1%)
African-American	1 (4.5%)	3 (15.7%)
Asian	1 (4.5%)	0 (0.0%)
Total	22 (100.0%)	19 (100.0%)

Note: Group B received the Nemeth Code tutorial intervention in Year 1 of the study; Group A was the control group in Year 1, and received the Nemeth Code tutorial intervention in Year 2.

**Table 3.** Descriptive Statistics for Math Reading Test Scores

Composite Math Reading Score	Group	N	M	SD
Time 1 (Year 1)	Group A	21	26.05	11.91
	Group B	17	29.24	20.27
	Total	38	27.47	16.03
Time 2 (Year 1)	Group A	21	32.95	12.88
	Group B	17	44.65	20.85
	Total	38	38.18	17.67
Time 3 (Year 2)	Group A	21	32.67	12.81
	Group B	17	41.71	21.59
	Total	38	36.71	17.64
Time 4 (Year 2)	Group A	21	43.90	12.43
	Group B	17	47.00	21.24
	Total	38	45.29	16.76

*Note: Group B received the Nemeth Code tutorial intervention in Year 1 of the study; Group A was the control group in Year 1, and received the Nemeth Code tutorial intervention in Year 2.*

scores from the math writing test (.94 and .95 for the pre- and posttests, respectively). For the second-year data, split-half reliability was again strong for the math reading test (.96 for both the pre- and posttests), and also for the math writing test (.94 and .95 for the pre- and posttests, respectively).

## Results

When the growth patterns of the two groups of participants (Group A and Group

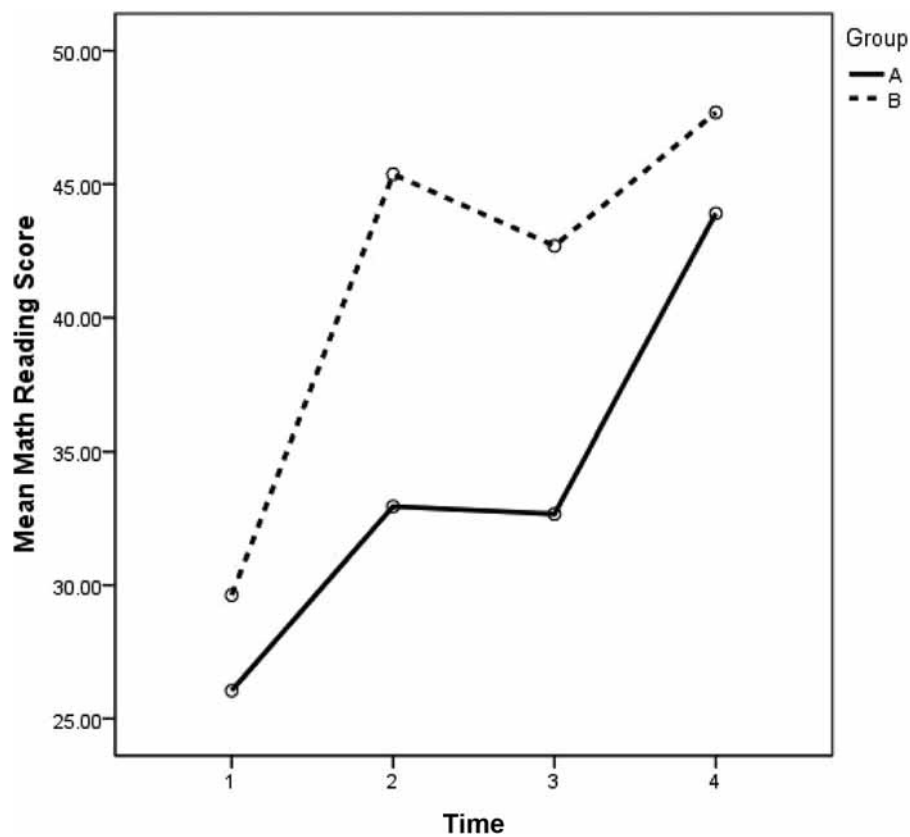
B) were compared, a statistically significant group difference was apparent for both math reading test scores,  $F(3, 34) = 6.70$ ,  $p < .01$ , and math writing test scores,  $F(3, 36) = 12.98$ ,  $p < .01$ . Figure 1, on math reading test scores, and Figure 2, on math writing test scores, illustrate these growth patterns.

Linear contrasts were then constructed to examine the difference in growth between Groups A and B from Time 1 to Time 2

**Table 4.** Descriptive Statistics for Math Writing Test Scores

Composite Math Writing Score	Group	N	M	SD
Time 1 (Year 1)	Group A	22	11.05	7.61
	Group B	18	15.56	15.59
	Total	40	13.08	11.93
Time 2 (Year 1)	Group A	22	15.55	7.21
	Group B	18	31.89	17.93
	Total	40	22.90	15.36
Time 3 (Year 2)	Group A	22	16.86	8.02
	Group B	18	28.56	16.81
	Total	40	22.13	13.88
Time 4 (Year 2)	Group A	22	25.91	9.81
	Group B	18	30.22	18.83
	Total	40	27.85	14.53

*Note: Group B received the Nemeth Code tutorial intervention in Year 1 of the study; Group A was the control group in Year 1, and received the Nemeth Code tutorial intervention in Year 2.*

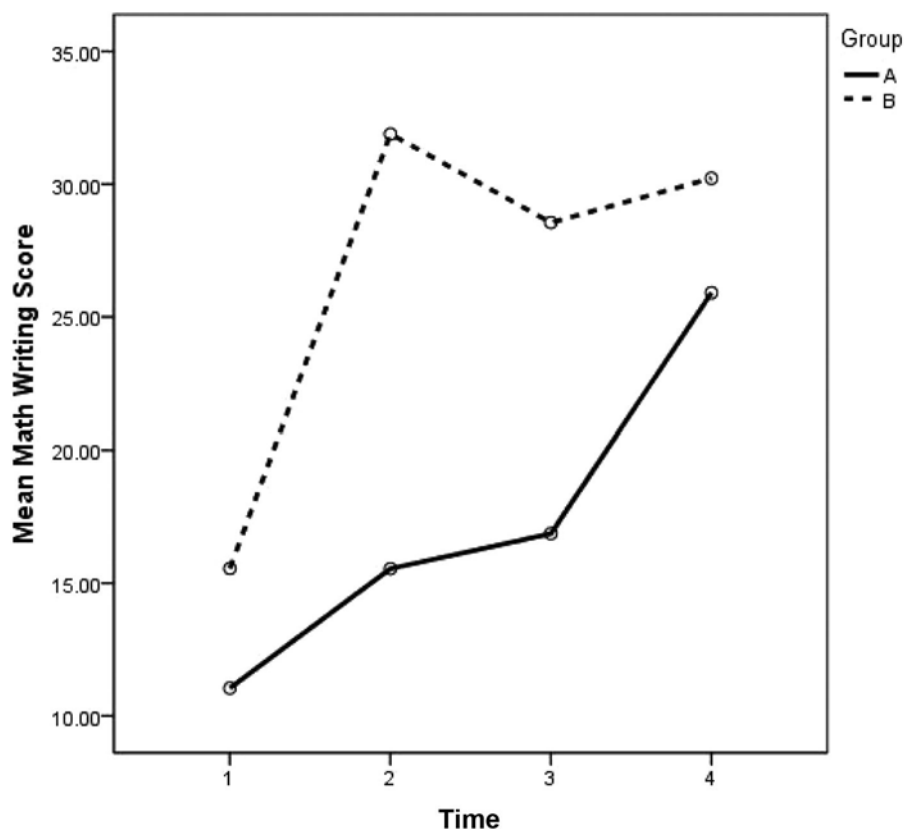


**Figure 1.** *Growth in Math Reading Test Scores, by Treatment Condition.*  
*Note:* Group B received the Nemeth Code tutorial intervention from Time 1 to Time 2; Group A was the control group from Time 1 to Time 2, and received the Nemeth Code tutorial intervention from Time 3 to Time 4. Between Time 2 and Time 3, students were on summer break.

specifically (i.e., the first year of the study, when Group A *did not* receive the tutorial intervention and Group B *did* receive the tutorial intervention). Here, a significant difference in growth was apparent for reading test scores,  $F(1, 36) = 7.14, p = .01$ , and writing test scores,  $F(1, 38) = 22.92, p < .01$ . In both outcomes (math reading and math writing), Group B increased at a greater rate than Group A, with large effect sizes for the group differences ( $\eta^2 = .16$  and  $\eta^2 = .38$  for math reading and math writing outcomes, respectively). Similarly, when linear contrasts were specified to examine group differences in growth from Time 3 to Time 4 (i.e., the second year of the study, when Group A *did* receive the tutorial intervention, and Group B *did not*), a statistically significant difference in growth was apparent between groups for both

math reading,  $F(1, 36) = 6.74, p = .01$ , and math writing,  $F(1, 38) = 18.64, p < .01$ . Here, Group A showed a greater rate of growth than Group B. Large effect sizes ( $\eta^2 = .16$  and  $\eta^2 = .33$  for math reading and math writing, respectively) were evident.

During the summer period between Time 2 and Time 3 (when students were not attending school), the math reading test scores decreased for both Group A and Group B, although these decreases were not statistically significant. Moreover, when the change in math reading test scores during this period was compared for Groups A and B, the difference between groups was not statistically significant:  $F(1, 36) = 3.56, p = .07$ . However, when the math writing test scores were considered for Time 2 to Time 3, Group B decreased while Group A increased, and the difference between the



**Figure 2.** *Growth in Math Writing Test Scores, by Treatment Condition.*

*Note:* Group B received the Nemeth Code tutorial intervention from Time 1 to Time 2; Group A was the control group from Time 1 to Time 2, and received the Nemeth Code tutorial intervention from Time 3 to Time 4. Between Time 2 and Time 3, students were on summer break.

two groups was statistically significant:  $F(1, 38) = 11.92, p < .01$ . This observation, however, was not surprising, as Group B had made large gains from Time 1 to Time 2, and thus had “more to lose” than the students in Group A, who had made more modest gains during this initial time period.

## Discussion

The results of this follow-up study lead to two major points. First of all, during the second year of the study, the former control group students (Group A) demonstrated significantly greater growth than the former treatment group (Group B) after exposure to the Nemeth Code tutorial. This finding replicates the results of our initial study. Thus, it can be concluded with some confidence that the tutorial is a very effective tool

that can be used by teachers to provide instruction in reading and writing the braille math code.

A second conclusion to be drawn from these data is that the tutorial has significant long-term effectiveness. That is, the former treatment group students who completed the pretests and posttests during the second year demonstrated very little loss in their knowledge of the Nemeth Code one year after the initial intervention.

Based on these results, the use of the BrailleNote Nemeth Code tutorial is highly recommended in order to help students who read braille to access math symbols. If individuals who blind are to be given the opportunity to be contributing members of society by being gainfully employed, then they must be given an opportunity to master the requisite quantitative skills. In order for



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them to do this, they must be able to study mathematics and disciplines that require skills and knowledge in mathematics. The ability to read and write braille mathematics is an essential skill for the study of mathematics. The Nemeth Code tutorial for the BrailleNote is an effective tool which facilitates students' efforts to master the reading and writing of math notation—in turn, enabling students who are blind to reach adequate levels of achievement in this area.

## Limitations

There were several limitations in this study. First, although one intent of the study was to replicate the results from Kapperman et al. (2011), this cannot be considered a pure replication because the year 2 control group consisted of students who were members of the treatment group in year 1. As such, this year 2 control group could potentially have had access to the Nemeth Code tutorial. Also, a reduction in sample size occurred after the first year of the study due to uncontrollable factors (teacher transfers, graduation, etc.). However, the significant effects, even with the reduced sample size, indicate some robustness in the effect of the tutorial.

## References

Amato, S. (2002). Standards for competence in braille literacy in teacher preparation pro-

grams. *Journal of Visual Impairment & Blindness*, 96(3), 143–153.

Demario, N., & Lian, G. (2000). Teachers' perceptions of need for and competency in transcribing braille materials in the Nemeth Code. *Journal of Visual Impairment & Blindness*, 94(1), 7–14.

Demario, N., Lang, S., & Lian, G. (1998). Teachers' self-assessed competence and attitude toward literary braille and Nemeth Code. *Journal of Visual Impairment & Blindness*, 92, 354–357.

Kapperman, G. (1994). [Survey of knowledge of the Nemeth Code by special educators and rehabilitation teachers]. Unpublished raw data. Sycamore, IL: Research and Development Institute.

Kapperman, G., Sticken, J., & Smith, T. (2011). The effectiveness of the Nemeth Code tutorial for the BrailleNote. *Insight: Research and Practice in Visual Impairment & Blindness*, 4(1), 22–28.

Nemeth, A. (1962). *Nemeth Code of Braille Mathematics*. Louisville, KY: American Printing House for the Blind.

Rosenblum, L. P., & Amato, S. (2004). Preparation in and use of the Nemeth Braille Code for Mathematics by teachers of students with visual impairments. *Journal of Visual Impairment & Blindness*, 98(8), 484–495.

Wittenstein, S. H. (1993). *Braille literacy: Pre-service training and teacher attitudes, report of a national study*. Unpublished doctoral dissertation. New York: Columbia University Teachers College.

# Assistive Technology Use Linked to Learning Theory: A Theoretical Framework

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## Abstract

The learning theory of educational psychology was applied to the use of assistive technology among students with visual impairments to gain a better understanding of the potential impact of the increased use of assistive technology in today's technologically driven climate. The application of three important theories—social cognitive theory, self-determination theory, and constructivism—to the field of visual impairment showed how assistive technology-supported learning experiences can foster self-efficacy, autonomy, self-regulation, independence, and the retention of knowledge for students with visual impairments. Current research and practice in the area of assistive technology are considered. Supporting concrete examples are provided through a real-world scenario to make a practical connection.

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**Keywords:** assistive technology, visual impairment, educational psychology, learning theory, child development

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## Introducing Julio

Julio is a second-grade student with a severe visual impairment caused by an eye condition acquired at birth. He reads braille and uses assistive technology to access the sighted world. His parents and teachers devised a suitable educational program in a typical second-grade class. The use of assistive technology is a major component in making Julio's learning possible. With the use of assistive technology, Julio can read the printed daily schedule on the interactive whiteboard in front of the classroom, since it is displayed instantly on his tablet that reads text aloud and is connected wirelessly to the

refreshable braille display on his electronic braille notetaking device. He prints his homework assignments from the electronic braille notetaking device and hands the homework to his classroom teacher at the same time as his sighted peers when the homework is due at the start of the school day. Julio knows that his graded homework will be returned to him in a timely manner when his classmates all receive their graded work. He is already looking forward to the quick feedback because it motivates him. Then, he researches an online definition for the vocabulary word of the day and participates in the discussion about what the word means with a group of his sighted classmates who researched the same word online at the same time as Julio

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## Assistive Technology

from their own tablets. Julio accomplishes each of these tasks without sighted assistance. This all happens within minutes of the start of the school day, and similar methods of providing Julio with instantaneous access to printed information continue throughout each academic activity. Even though Julio cannot see well, he does not seem to miss out on activities or information. The impact on Julio's overall well-being is truly remarkable compared to what his experience would be like if the use of assistive technology were removed from his daily routine.

This scenario is intended to show how assistive technology-supported learning experiences foster healthy child development in many areas beyond the academic curriculum. A positive impact on self-efficacy, autonomy, self-regulation, independence, and knowledge retention may be likely outcomes for Julio. It is worth considering all aspects of Julio's development when providing him with the benefit of using assistive technology. A theoretical framework follows that considers current research and practice in this area of the use of assistive technology to provide such a connection. Julio's scenario is revisited several times to provide the supporting and concrete real-world examples described in this article.

## The Theoretical Framework and Prevalence of the Use of Assistive Technology

Over the course of the history of child development, innovations in technology have been fundamental in determining life paths. As Bandura (1989) explained, technological innovations guide many of the changes and expectations in social and economic life. Today's technology-based society makes learning to use high-tech equipment an imperative component of education for students with and without disabilities in the United States. The need for technology in order to keep up with changes in the workforce affects the education of

students with visual impairments (that is, those who are blind or have low vision). Students who are visually impaired and unable to use word-processing programs, for example, will find substantial limitations on their marketability for jobs because they are unable to read electronic documents without sighted assistance (Abner & Lahm, 2002). Proficiency in adaptive computing skills is a component of basic literacy that students with visual impairments must learn and master before they can make vocational decisions (Luxton, 1990). Confidence and skill in the use of assistive technology devices in daily life are critical for primary- and secondary grade-level students who are visually impaired to participate fully in society. With this confidence and skill, technology can be a great equalizer for students who are visually impaired (Hatlen, 1996). Without this fluency in the use of adapted software and other special electronic devices for those who are visually impaired, technology may hinder healthy child development.

## Prevalence of the Use of Assistive Technology

Many students who are visually impaired have not yet benefitted from using assistive technology even though a variety of devices and tools are widely available in the marketplace (Abner & Lahm, 2002). Kelly (2011) demonstrated that nearly 60% of high school students with visual impairments were not using high-tech assistive technology, such as software that reads the print shown on the computer screen or that enlarges the size of the print on the computer screen. This finding concurred with that of Kapperman, Sticken, and Heinze (2002) and Kelly (2009). Both studies also found that approximately "60% of the students who, in the authors' judgment, could benefit from the use of assistive technology were not given the opportunity to use it" (Kapperman et al., p. 107). Kelly (2009) assessed a nationally representative sample of elementary and middle school students with visual impairments, and Kapper-

man et al. (2002) conducted a statewide survey in Illinois with a sample of students across several grade levels. In each instance described here (Kapperman et al., 2002; Kelly, 2009; 2011), the studies surveyed the use of assistive technology by academic readers (i.e., those who read braille or large print) who were therefore likely to have benefitted from assistive technology training with high-tech devices and software.

Thus, it has been established that less than half the students with visual impairments were using the assistive technology that they needed to be using. Kelly (2009; 2011) showed that this finding pertained to students with visual impairments regardless of their grade level or their specific geographic location within the United States.

## **Use of Assistive Technology Linked to Learning Theory**

This theory paper addresses the disconcerting level of use of assistive technology just reported. The learning theory of educational psychology was applied to gain a better understanding of the potential impact of the increased use of assistive technology in today's technologically driven living, learning, and working environments. Learning theory involves the study of the methods, origin, nature, and limits of knowledge (Schunk, 2004). The theoretical framework is a unique combination of two otherwise distinct disciplines. This examination was intended to further advancement in the use of and training of students with visual impairments in assistive technology.

## **Examining the Theoretical Framework**

The following theoretical question was explored: How can assistive technology-supported learning experiences foster self-efficacy, self-regulation, independence, and academic performance for students with visual impairments? Social cognitive theory was used to investigate the connection between self-efficacy and the use of assistive

technology. Self-determination theory provided a foundation for autonomy and self-regulated learning outcomes. The area of learning theory known as constructivism explained increased independence as a learning outcome. Table 1 presents the operational definition of each of these theoretical backgrounds and associated learning outcomes. The presentation of the theoretical framework was supported by learning theory and several concrete examples from Julio's scenario.

### **Self-Efficacy**

Self-efficacy is the accurate self-appraisal of personal capabilities (Bandura, 1989) that can form career aspirations and the desire for other undertakings early in life (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996). Belief in one's ability to exercise control over one's performance and environmental demands is a central mechanism that inspires or prohibits human actions. Unless learners believe they can create desired outcomes with their actions, they have trivial incentives to act or progress with their cognitive development (Bandura et al., 1996).

Social cognitive theorists believe the interdependent interactions between the learner, the environment, and the learner's behavior can strengthen or weaken self-efficacy. The bidirectionality (i.e., functioning in two opposite directions) of the relationships between these three sources of influence means that learners are products and producers of their environment (Bandura, 1989). The three sources of influence vary in the impact they have on self-efficacy.

### ***What Does This Mean for Julio?***

The classroom schedule is displayed on an interactive whiteboard that Julio cannot see from any reasonable distance. Julio's classroom teacher provides printed homework worksheets to be completed each evening. Julio has never actually seen his classroom walls decorated with concepts he has been learning about the entire

Table 1. Operational Definitions of Theoretical Terminology

Learning Theory	Operational Definition of Learning Theory	Associated Learning Outcomes	Operational Definition of Associated Learning Outcomes
Social cognitive theory	The learner, the learning environment, and the learner's behavior are interdependent and either strengthen or weaken self-efficacy	Self-efficacy	Belief in control over the environment that gives learners incentives to progress
Self-determination theory	Intrinsic motivation is self-determined and begins with behaviors that were originally extrinsically motivated	Autonomy, self-regulation	The ability of learners to take charge of their own learning experiences
Constructivism	On the basis of social interactions, the coconstruction of knowledge between people and human development is shown through the use of tools (i.e., language and symbols)	Independence, retention of knowledge	Maximizing the difference between what learners can do with and without assistance from others to promote cognitive development; the ability to retain learned information

*Note: Adapted from Schunk, 2004.*



school year. The absence or lack of vision can make it significantly more difficult to access and acquire critical information about academic environments (Sacks & Silberman, 2000).

The intersection between social cognitive theory and the use of assistive technology in the education of students with visual impairments revealed the empowerment that these special devices can offer by enabling Julio to have increased access to materials in his academic environment. Julio experiences many more aspects of the learning environment when he uses assistive technology to complete his schoolwork alongside his sighted peers.

Julio has instant access to microscopic or small objects, printed or handwritten text, and graphic materials when he uses assistive technology. This increased interaction with everyday school materials strengthens the relationship between Julio (the learner) and his classroom (the environment). The learning environment that is enriched with assistive technology devices and software can be the foundation for changing the way individuals perceive themselves and their potential (Luxton, 1990). The development of Julio's self-efficacy and Julio's use of assistive technology are interdependent components of his development.

### **Autonomy and Self-Regulation**

The increase in autonomy for students with visual impairments who learn to use assistive technology can be explained by self-determination theory. Research on self-determination theory examines social-contextual conditions that strengthen or weaken intrinsic motivation, self-regulation, and well-being (Ryan & Deci, 2000). Assistive technology can empower students with the ability to take control of their own learning experiences because these students are better equipped with the necessary tools and information for self-regulatory behaviors (Duhaney & Duhaney, 2000). When students with visual impairments do not have access to visual information, they are externally regulated by teachers, other

adults, and sighted peers. Students who are externally regulated show less interest in and effort in achieving academically and a tendency to blame others for negative outcomes, rather than display more positive coping styles (Ryan & Deci, 2000). More autonomous and self-regulated learning experiences are associated with more engagement and better academic achievement by students who are in control of their learning (Ryan & Deci, 2000). Thus, the use of assistive technology plays a vital role in the ability of students with visual impairments to take charge of their own learning.

To shape self-regulation, frequent and timely feedback is another critical component. Gallimore and Thorpe (1990) explained that providing feedback is the most effective way of giving assistance for self-regulation. Students with visual impairments who use assistive technology are empowered with the ability to have instantaneous access to information and the ability to read printed materials independently and without sighted assistance (Gerber, 2003).

Holbrook, Wadsworth, and Bartlett (2003) studied teachers' perceptions of students' use of a special high-tech writing device for people who are visually impaired that translated between print and braille text instantaneously. The results showed that immediate written communication among students with visual impairments, their sighted peers, and their classroom teachers was motivating for everyone involved.

### ***What Does This Mean for Julio?***

Julio edits his own schoolwork and turns in his own homework assignments to his classroom teacher at the same time as his sighted peers. He receives his graded homework back at the same time as his classmates with no extra delays or sighted assistance involved—the feedback process is streamlined. Julio is not dependent on sighted assistance to participate in his school day. It is up to Julio to research the online definition for the vocabulary word of

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the day and ask questions about the daily schedule as he reads it on his tablet at the start of the school day.

Julio is autonomous in many learning experiences and is not externally regulated by others. He has instant access to the second-grade curriculum when he uses assistive technology. The self-regulation that Julio has already established as a second grader has provided him with a lifelong foundation for being more motivated and more empowered. As such, high academic achievements are likely to follow for Julio.

## Independence

The assistive technology learning process can be enhanced with certain instructional techniques that increase students' independence. This application of social cognitive learning theory highlights the role of the instructor's expertise. The scaffolding of instruction is a technique used to support students' learning. This instructional strategy provides students with more assistance when a task is new or difficult. When a task is mastered, the support of the instructor is gradually removed so that the student can accept more responsibility and become more independent with the task at hand (Larkin, 2001). Thus, the scaffolding instructional technique can increase independence in the learning process. To provide the assistance necessary to scaffold instruction appropriately, educators must have mastery of the content of the material the students need to learn. Teachers of students with visual impairments with comprehensive knowledge about assistive technology for students who are visually impaired can scaffold their instruction and provide students with the supports that are necessary to learn to use specialized technology independently as they gradually remove themselves from certain learning tasks.

In addition to the scaffolding of instruction, there are other specific teaching strategies that promote higher levels of independence and create an optimal learning environment. These strategies are encouragement, conceptual questions, direct relin-

quishing statements, and physical withdrawal of the instructor (Diaz, Neal, & Amaya-Williams, 1990). With the use of assistive technology, students are provided with a forum for these strategies.

### ***What Does This Mean for Julio?***

Julio would experience minimal instructional scaffolding during his school day without the strong presence of assistive technology. There would be fewer possibilities for the instructor's withdrawal if assistive technology were not fully integrated into Julio's learning environment. Independence would be far more difficult or not possible for Julio to achieve in many activities that his sighted peers participate in on their own.

Students with visual impairments commonly report that they desire a tangible sense of wholeness and independence in the ability to edit schoolwork or take a test on their own (Luxton, 1990). Julio, on the other hand, does all these things on his own and will continue to do so in many additional ways as he grows. Assistive technology provides Julio with a sense of liberation, which is a necessary component of healthy child development (Luxton, 1990).

## **Access to Information and Retention of Knowledge**

A relevant aspect of constructivism to this theoretical framework is the role of tools in the learning environment and how students interact with tools in learning tasks. Students who are visually impaired and use assistive technology have access to more learning tools and, therefore, more information than have students with visual impairments who lack these means. As Vygotsky (1978) explained, tools are the mediator between people and their work. Without the appropriate learning tools, the connection between students and their schoolwork is severed. Resnick (1987) capitalized on the Vygotskian framework with the assertion that cognitive activity in classrooms depends on the availability of tools. Assistive technology tools can create this cognitive activity by improving cognition, affect, and

cooperative learning skills (Duhaney & Duhaney, 2000). Furthermore, tools give students a way to create cues in their environment that cause them to remember academic concepts (Vygotsky, 1978).

### ***What Does This Mean for Julio?***

Julio writes his spelling list in his electronic braille notetaking device in preparation for studying for the weekly spelling test. In doing so, Julio creates artificial stimuli or cues to help himself remember.

A similar process occurs with Julio's tablet. For example, what are the steps involved in creating homemade Play-Doh during today's science lab? It is all there for Julio to review on the tablet that reads text aloud. The refreshable braille display of his electronic braille notetaker is connected wirelessly to the tablet. Text-based information from the tablet is displayed instantly on the refreshable braille display, ready for Julio to read in braille at the same time as his sighted peers are reading through the print version of the instructions. Julio is ready to participate in the science lab. In this way, the assistive technology tools have enabled Julio to increase his cooperative learning during hands-on activities. With the use of assistive technology learning tools, Julio is not a passive participant dependent on his sighted peers to talk him through each process. This sort of direct and purposeful involvement with the tasks at hand has an impact on Julio's cognition and affect in the most positive ways.

Someday in the not too distant future, Julio will be in middle school and then in high school. He will be taking notes with an accessible personal digital assistant (PDA) similar to what he uses today. He will record pertinent information presented to him in all sorts of complex classes. As Julio moves on to the higher grade levels, he will learn to take notes using his PDA during a lecture and retrieve the information from the same PDA at a later time. Assistive technology allows for knowledge retention and access to information in this particular way. Assis-

tive technology is and will continue to be a fundamental tool and mediator in the learning process for Julio.

## **Conclusion**

The application of learning theory to the field of visual impairment explicitly connected these two traditionally separate disciplines and demonstrated how learning experiences that involve the use of assistive technology can foster self-efficacy, autonomy, self-regulation, independence, and knowledge retention for students with visual impairments. From this connection between two disciplines, the theoretical framework emerged. A relationship between the use of assistive technology by students with visual impairments and the underlying learning theory that supports many developmental benefits of its use was presented. Added practical details were provided through Julio's scenario to demonstrate how the theoretical framework can be applied immediately and in countless ways.

Confidence, skill, and experience with technology are necessary for healthy child development regardless of a child's disability status (Rideout, Foehr, & Roberts, 2010). For students who are visually impaired and need to reach certain developmental milestones (e.g., increased independence or strengthened self-efficacy), the use of assistive technology can make the difference in their achievement. Technology is essential for children who are growing up in this digital era. In addition, it is necessary to develop a skill set that enables youngsters to use the most modern devices and software. Given the current level of use of assistive technology that was established by prior research (Kapperman et al., 2002; Kelly, 2009; 2011), there is a need to embrace the theoretical framework presented in this article and, in doing so, increase the use of assistive technology by students with visual impairments nationwide.

This theoretical review was not an exhaustive review of the literature. More information is likely available that can strengthen

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the connection between learning theory and the need for the use of assistive technology in the everyday learning experiences of students with visual impairments. The theoretical framework presented here can be further developed as newer technology continues to emerge. Future studies devoted to the use of assistive technology should seek to understand the implications for child development and students, like Julio, who would otherwise be more limited than they are in their successful completion of everyday tasks and activities.

## References

Abner, G., & Lahm, E. (2002). Implementation of assistive technology with students who are visually impaired: Teachers' readiness. *Journal of Visual Impairment & Blindness*, 96, 98–105.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development: Vol. 6. Six theories of child development* (pp. 1–60). Greenwich, CT: JAI Press.

Bandura, A., Barbaranelli, C., Caprara, G., & Pastorelli, C. (1996). Multifaceted impact of self-efficacy beliefs on academic functioning. *Child Development*, 67, 1206–1222.

Diaz, R., Neal, C., & Amaya-Williams, M. (1990). The social origins of self-regulation. In L. Moll (Ed.), *Vygotsky and education* (pp. 127–154). Cambridge, England: Cambridge University Press.

Duhaney, D., & Duhaney, L. (2000). Assistive technology: Meeting the needs of learners with disabilities. *International Journal of Instructional Media*, 27, 393–401.

Gallimore, R., & Thorpe, R. (1990). Teaching mind in society: Teaching, schooling, and literate discourse. In L. Moll (Ed.), *Vygotsky and education* (pp. 175–205). Cambridge, England: Cambridge University Press.

Gerber, E. (2003). The benefits of and barriers to computer use for individuals who are visually impaired. *Journal of Visual Impairment & Blindness*, 97, 536–550.

Hatlen, P. (1996). The core curriculum for blind and visually impaired students, including those with additional disabilities. *RE:view*, 28, 25–32.

Holbrook, M., Wadsworth, A., & Bartlett, M. (2003). Teachers' perceptions of using the Mountbatten Braille with young children. *Journal of Visual Impairment & Blindness*, 97, 646–654.

Kapperman, G., Sticken, J., & Heinze, T. (2002). Survey of the use of assistive technology by Illinois students who are visually impaired. *Journal of Visual Impairment & Blindness*, 96, 106–108.

Kelly, S. M. (2009). Use of assistive technology by students with visual impairments: Findings from a national survey. *Journal of Visual Impairment & Blindness*, 103, 470–480.

Kelly, S. M. (2011). Assistive technology use by high school students with visual impairments: A second look at the current problem. *Journal of Visual Impairment & Blindness*, 105, 235–239.

Larkin, M. (2001). Providing support for student independence through scaffolded instruction. *Teaching Exceptional Children*, 34, 30–34.

Luxton, K. (1990). Training students in adaptive computer technology. *Journal of Visual Impairment & Blindness*, 84, 523–525.

Resnick, L. (1987). Learning in school and out. *Educational Researcher*, 16, 13–20.

Rideout, V., Foehr, U., & Roberts, D. (2010). *Generation M: Media in the lives of 8–18-year-olds* (Report 8010). Menlo Park, CA: Henry J. Kaiser Family Foundation.

Ryan, R., & Deci, E. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68–78.

Sacks, S., & Silberman, R. (2000). Social skills. In A. J. Koenig & M. C. Holbrook (Series Eds.), *Foundations of education: Vol. 2. Instructional strategies for teaching children and youths with visual impairment* (2nd ed., pp. 616–652). New York: AFB Press.

Schunk, D. H. (2004). *Learning theories: An educational perspective* (4th ed.). Englewood Cliffs, NJ: Merrill.

Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.



# Preparation Starts Early: High School-to-College Transition Activity Calendar

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## The Need for Transition Services

A growing body of literature has emerged about the importance of effective transition services for high school students with disabilities, particularly those who are blind or visually impaired, to prepare for appropriate employment or readiness and acceptance into college. Making the move from high school to college, while a long-awaited rite of passage, is fraught with challenges and trepidation, as well as excitement, for all young people. For students who are blind or visually impaired, there is a broad array of extra steps to assist in making the transition smooth, and a systematic sequencing of activities to make the process more manageable (Dote-Kwan & Senge, 2002; Trief & Feeney, 2005).

Many of the tasks that are necessary require early preparation that many students do not think about or consider important for getting into college, such as volunteer or part-time work experience or assuming an active or leadership role in a high school committee or organization. Not all students have access to the expert guidance and support they need in order to make for a smooth progression through each grade. Students need to know the importance of advocating for themselves, such as being an active participant in their Individualized Education Program (IEP) meetings as early as possible. They need to be involved when important decisions are being made about

their future—such as course selections, opportunities for advanced placement, and taking advantage of many summer transition programs to prepare them for college. Without these opportunities, many students find themselves struggling in their senior year of high school to complete activities that they should have been engaging in throughout high school and earlier.

Knowing that you want to go to college is not enough. The road is arduous, and it is helpful to have a road map to direct you through the process. For students who are blind or visually impaired and heading to college, a sequential map of steps to be accomplished enables most to be “raring to go” on the first day of class.

## Development of a Transition Tool

The National Research and Training Center on Blindness and Low Vision at Mississippi State University (MSU-NRTC), as part of their transition grant (number H133A070001) from the National Institute of Disability Rehabilitation Research (NIDRR), has developed an online Transition Activity Calendar for students, their families, and those who work with them. This new online transition calendar is an extensive checklist starting in middle school and progressing through the high school years until the student starts college. It is an updated, expanded, and redesigned version of the popular Transition Activity Calendar (McBroom et al., 1996), also a product of the MSU-NRTC. The new online Transition Activity Calendar is a tool that provides suggestions

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for identifying a career goal and taking the necessary classes toward that career, and shows how to take every advantage of the transition services available in each student's community. From selecting the right major to learning to use the most efficient assistive technology, from finding the college best suited to a particular course of study to participating in campus life, the demands of good preparation start early and continue through high school and into the summer before the fall semester when college begins.

The Transition Activity Calendar may be used by individual students or in groups in conjunction with their special education teacher, and it may be a useful tool for existing transition programs. Most U.S. states have some type of transition program for college-bound students with disabilities, but some may not include specific programming for students who are blind or visually impaired. Programs vary considerably and may be sponsored by education agencies, local schools, vocational rehabilitation services, or private nonprofit agencies, or through colleges themselves. The Transition Activity Calendar can be useful in all these settings and also in preparing students to attend such programs.

The NIDRR grant that provided for the Transition Activity Calendar contained several research points related to a variety of factors that enhanced students' abilities to become employed after high school or college. College is a major step toward certain types of employment, and integrating many of the following factors into both college preparation and employment preparation can be beneficial to students and give them tools to enhance their employability. According to research by McDonnall and Crudden (2009), some factors associated with positive employment outcomes include early work experience in a variety of settings, academic competence, self-determination, use of assistive technology, and locus of control. Other research-identified issues were good communication and independent living skills,

problem-solving skills, and career development activities (Crudden, 2011). A systematic research review by Cavanaugh and Giesen (2011) identified experimental studies addressing factors such as career exploration, social skills, assertiveness training, and paid work experience, and how these factors made an impact on certain aspects of employment. In preparing for college, there are also other factors that students who are blind and visually impaired need to address, such as selecting a college with various supports that the student may identify as important, the logistics of getting into college, arranging for accessible textbooks, and learning the self-advocacy skills necessary to discuss their disabilities with professors (Dote-Kwan & Senge, 2002; Trief & Feeney, 2003; 2005; Wolffe, 2000). Designed with college as a step to employment in mind, tasks and activities in the Transition Activity Calendar include many of these factors as part of a checklist of activities that can supplement and impact college planning.

Based on the many requests for the previous transition calendar and on informal feedback from those who have used it, it is anticipated that the Transition Activity Calendar for students with visual impairments will be a valuable tool for students, parents, special educators, transition specialists, and vocational rehabilitation personnel to help students with visual impairments prepare for college. The newly released online version incorporates suggestions from the grant research regarding developing social skills and a variety of work experiences, as well as information on topics such as e-text and online library access. The new Transition Activity Calendar, in its online format, is intended to be a dynamic, ever-changing instrument that will contain specific activity suggestions and supplemental information to assist in preparing young adults for a positive college experience. The online format contains links to supplemental information and provides opportunities for adding suggestions from the field and those who have used it.

## Examples of the Information It Contains

### *Middle School*

The following are some examples from the Transition Activity Calendar, starting with those for students in middle school:

- Start thinking about possible careers that you are interested in exploring and assess your skills and abilities.
- Discuss your interests and capabilities with your parents, special education teacher, school guidance counselor, or another trusted teacher or adult. Read books about what people do for careers, attend career fairs, and talk with people in your community about their careers and the educational training that prepared them. (Resources to consider are Kernel Books by the National Federation of the Blind: [http://www.nfb.org/nfb/Kernel\\_Books.asp](http://www.nfb.org/nfb/Kernel_Books.asp).)
- If you have not done so before, now is a good time to learn how to download books and to read both audiobooks (which use a narrator) and e-text (which uses synthesized speech). If you want to go to college, the vast amounts of reading it requires will necessitate such skills in order to keep up. Now is a good time to start practicing if you have not already done so.
- When you are 14 years old, ask about vocational rehabilitation services in your state. Find out who your rehabilitation counselor would be. Call and introduce yourself and learn about services that are available, and how old you have to be to apply. To find the vocational rehabilitation office near you, check for information in the MSU-NRTC online directory of state vocational rehabilitation agencies: <http://www.blind.msstate.edu/referral/ncsab>. Vocational rehabilitation is not mandated for all people with disabilities, and you have to be found eligible

based on severity of vision loss and future employability. Vocational rehabilitation can be very beneficial in assisting you to get the training and skills you need to succeed. You will have to qualify for these services, but in some states they can assist you in finding a part-time or summer job while you are still in school.

- If you have not already learned to use the assistive technology you need before middle school, now is the time to start.

### *High School*

What follows are a few examples of activities to accomplish in the 11th grade. Once the student reaches high school, the Transition Activity Calendar identifies activities by month (the following information is slated for October):

- Take standardized admission tests such as the PSAT (Preliminary Standard Aptitude Test). Taking the PSAT in 11th grade gives you a good idea of the type of test it is. It will prepare you to take the SAT (Standard Aptitude Test) in the 12th grade. Your score on the PSAT is used to qualify you for National Merit Scholarships.
- Check out the SAT requirements for students with disabilities at <http://sat.collegeboard.org/register/for-students-with-disabilities> and <http://www.collegeboard.com/ssd/student>. Note that any accommodations must be approved in advance of the test, and no one will be approved if the request is made less than two weeks before the test date.
- For students who are blind or visually impaired, there are several accommodation options: large-print exams and answer sheets, computers, audio access or readers, additional testing time, braille editions, and extra or extended breaks.
- If you are planning to take the ACT (American College Testing exam),

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check out information on their website at <http://www.collegeboard.com/ssd/student> and their accommodations section at <http://www.act.org/aap/disab/index.html>. Testing times and locations may be different for you, depending upon your accommodation requirements.

- Continue to investigate possible careers by participating in job fairs, career days, and field trips. As you are exposed to more careers, you may change your potential career path. If so, be sure to adjust your course of study accordingly.
- Arrange regular times to meet with your vocational rehabilitation counselor.

## Discussion

Students who are well prepared for the transition from high school to college have already learned strong self-advocacy skills during middle school and high school and have a strong sense of self-determination—all of which will enable them to successfully overcome the new challenges college brings (Trief & Feeney, 2005; Wolffe, 2000). They have learned additional skills necessary for students who are visually impaired in academic and social areas, as well as in independent living skills, including the use of appropriate assistive technology. They have also prepared early for the activities that are involved in finding the right college and in applying, getting oriented, and preparing for their classes.

The Transition Activity Calendar is free, and is available on the MSU-NRTC's website at <http://www.blind.msstate.edu/transistion/TAC>.

Note: The Transition Activity Calendar was developed as part of a Disability Rehabilita-

tion Research Project (DRRP) grant entitled *Transition Services that Lead to Competitive Employment Outcomes for Transition-Age Individuals with Blindness or Other Visual Impairments* from the U.S. Department of Education (NIDRR #H133A070001). The contents do not necessarily represent the policy of the U.S. Department of Education.

## References

Cavenaugh, B., Giesen, J. M., et al. (2011). A systematic review of transition interventions affecting successful employment outcomes of adolescents with visual impairments. Manuscript submitted for publication.

Crudden, A. (2011). Transition services: Components for success. Manuscript submitted for publication.

Dote-Kwan, J., & Senge, J. (2002). *Preparing for college and beyond: A guide for students with visual impairments*. Los Angeles: Braille Institute of America.

McBroom, L., et al. (1996). *Transition Activity Calendar*. Mississippi State, MS: Rehabilitation Research and Training Center on Blindness and Low Vision.

McDonnall, M. C., & Crudden, A. (2009). Factors affecting the successful employment of transition-age youth with visual impairments. *Journal of Visual Impairment & Blindness*, 103(6), 329–341.

Trief, E., & Feeney, R. (2003). Guidelines for a precollege curriculum for students with blindness and visual impairment. *RE:view*, 35(3), 137–143.

Trief, E., & Feeney, R. (2005). *College bound: A guide for students with visual impairment*. New York: AFB Press.

Wolffe, K. (2000). Making it! Successful transition competencies for youth with visual disabilities. *SEE/HEAR*, 5(2). Retrieved from <http://www.tsbvi.edu/seehear/spring00/makingit.htm>

# A Portable Cane Holder or How to Make a Cane Stand

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**Keywords:** orientation and mobility, cane storage, accessibility, activities of daily living, cognitive impairment, deaf-blindness, education, itinerant teaching, mobility and navigation

From 2009 to 2012, I provided orientation and mobility instruction to Sally (a pseudonym), a child who has multiple handicaps and attends a class for the severely developmentally delayed. She has a diagnosis of severe bilateral hearing loss and possible light perception loss. During the last school term (2011–2012) she made great progress using her cane, transitioning from an adapted mobility device to a graphite rigid cane with a roller tip and an elastic strap at the handle.

While using the adapted mobility device, Sally traveled independently to music and gym classes and to story time in the library. She kept her adapted mobility device centered and ahead of her body as she traveled in the hallways. The school building contained over 400 students in kindergarten through third grade. It had been added onto several times, creating unpredictable intersections. Guth and Reiser reported that regularity and predictability in an environment can provide important orientation information (1997, pp. 23–24). Nevertheless, Sally was able to independently travel with her cane to her usual locations with minimal adult assistance and guidance.

Sally's adapted mobility device was stored by her classroom door, leaning against the wall close to the right side of the door jamb, and it seemed natural to store her new cane in the same place. Because there was no place to lean the cane, a hook was installed to the right of the door. With some practice and assistance, Sally located her long cane and retrieved it from the hook. However, in other classrooms, especially rooms with large open spaces and doors without defined doorjambes such as the lunchroom and gym, storing the cane was a problem. The cane didn't seem to fit anywhere, so the classroom teacher would take it and return it when needed. Placement for cane storage varied not only by location but also in response to the preferences of each staff member. Everyone had a different idea about where to place the cane. Hence, Sally could not independently store or retrieve her cane.

In most classrooms, storage by a desk was not an option: Sally rarely had a desk. I therefore requested the installation of additional 2-inch metal wall hooks for long cane storage in her classes. Mr. Walker, the school's maintenance supervisor, attached a few hooks by classroom entrance doors. In no time, I realized that classrooms change and an accessible space right be-

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## Cane Storage



**Figure 1.** *The first method for building a cane stand, using surplus wood pieces.*

side a classroom's door wasn't always available. Also, hooks placed at 32 inches above the floor were just the right height for other students to bump into them. I needed a different storage system to augment the hooks.

An umbrella stand was considered, but these were too expensive and lacked stability. I decided to construct a cane holder that looked like an umbrella stand, but with a wider base to improve stability. A larger base could also be used to enhance object detection. I considered materials that were readily available from the school's maintenance building and could be assembled with few tools. I drew up plans for a portable cane holder and took them to our school's maintenance supervisor. The challenge was how to attach a 22-inch-long, 4-inch-diameter polyvinyl chloride (PVC) pipe to a square base. Mr. Walker came up with two possible solutions. The first one is cheaper and uses surplus wood pieces. This method requires the following materials:

- A 4-inch (*inside* diameter), white PVC pipe at least 22 inches long.

- A 12x12-inch piece of plywood, 5/8 inch thick (the base).
- A 4-inch-round disk cut out of 3/4-inch-thick plywood.
- Three 1-inch wood screws (size #10) for the disk, plus three 3/4-inch wood screws (size #8) for the PVC pipe.
- Wood glue.
- An electric drill with bits smaller than the screws' diameters.
- A flat screwdriver.
- 80- or 100-grit sand paper to clean the pipe. You can also try solvents to remove the printing on the pipe (paint may not cover the markings).
- Spray paint (your choice of color). Clean the stand before painting.

Some home improvement centers will cut the PVC pipe, plywood, and round disk for you. Ask at various centers.

The 4-inch-diameter PVC pipe will hold Sally's 36-inch long cane. This pipe stands upright on the 12-inch-square base of 5/8-inch-thick plywood. Mr. Walker studied the size of the base and reported that this size was needed to support the 22-inch-tall PVC pipe. Cut out a round 4-inch-diameter ply-



wood disk. The disk connects or attaches the long PVC pipe to the square plywood base (see Figure 1).

## Assembly Directions

- Have the pieces cut out and ready for assembly (the 22-inch-long 4-inch-diameter white PVC pipe, 12-inch-square plywood base, and 4-inch-diameter round disk).
- Set the 12-inch-square base on the floor.
- Then place the 4-inch-round disk in the center of the 12-inch-square base and glue it in place. Let it set for 12 hours to dry.
- Drill 3 holes (evenly spaced) through the round disk. The holes should be smaller than the #10 screws' diameter for a tight hold.
- Using the 3 #10 wood screws, screw the disk to the square base (screws go through the round disk into the square base).
- Drill 3 small holes approximately 3/8-inch from the bottom of one end of the PVC pipe and evenly spaced around the pipe's perimeter. The holes should be smaller than the #8 screws' diameter for a tight hold.
- Slide the PVC pipe (with the holes drilled at the bottom) over the 4-inch-round wood disk.
- Screw the three 3/4-inch (#8) wood screws through the PVC pipe and into the attached round 4-inch wood disk.
- The PVC pipe is now secured to the square base.
- Clean and sand markings off the PVC pipe, using 80- or 100-grit sandpaper.
- Spray paint your choice of color (clean the stand again before painting). Dark colors may hide any marking left on the pipe.

A second method of attaching the 22-inch-tall PVC pipe to the 12-inch-square plywood base was developed by Mr. Walker. He



**Figure 2.** *The second method for building a cane stand, using a toilet flange.*

suggested using a toilet flange. Toilet flanges come in various styles and sizes. Always check that the PVC pipe will fit your flange. Some companies, such as Sioux Chief and Oatey, make 4-inch PVC flanges with adjustable rings. The Push Tite (see Figure 2) does not need screws to attach the PVC pipe to the stand. This is a more expensive approach, as flanges range in price from \$3.50 to \$16.00, but it is a good option. The materials needed are:

- A 4-inch-diameter white PVC pipe at least 22 inches long.
- A 12x12-inch piece of plywood, 5/8-inch thick (the base).
- A toilet flange of your choice, with pre-drilled holes at the base.
- Three 1-inch wood screws for the base, and possibly 3 3/4-inch wood screws for the PVC pipe, depending upon which flange you select.
- An electric drill with bits smaller than the screws' diameters.
- A flat screwdriver.
- Use 80- or 100-grit sandpaper to clean the pipe. Also try solvents to remove

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the markings. Paint may not cover the markings.

- Spray paint (your choice of color).  
Clean the stand before painting.

## Assembly Directions

Follow steps 1–3, as above, then:

- Place the toilet flange in the center of the 12-inch-square base.
- Screw it onto the square base using 1-inch wood screws. Use at least 4 screws to secure the flange (the more screws, the better).
- After the flange is in place, slide the PVC pipe over the toilet flange and mark where the holes will be drilled (if using the Push Tite flange, skip to the painting stage).
- Drill 3 holes, evenly spaced  $\frac{3}{8}$  inch from the bottom of the 22-inch-tall PVC pipe.
- Slide the pipe down over the toilet flange and screw it into place.

In both methods, the square base is designed to be large enough to: (1) provide adequate stability; (2) protrude out of the PVC pipe for easy object identification by the traveler using a cane; and (3) give the student enough reaction time to stop before the pipe is hit.

Sally was encouraged to use tactile exploration to learn about the stand and its shape. The stand's use was demonstrated in a hand-under-hand fashion. She practiced using it, and the task of approaching the stand and placing her cane into it was broken down into steps. She then participated in the stand's placement in her classroom and practiced using it in that specific location. The cane lesson was broken down as follows:

- approach the stand;
- locate it with the cane;
- upon contact, stop;
- reach forward to locate the pipe with a free hand;
- position the cane vertically;



**Figure 3.** Example of a completed cane stand painted in a high-contrast color.

- slide one hand a little down the cane;
- lift up the cane;
- keep the free hand on the PVC pipe opening;
- guide the cane's tip into the stand opening;
- slide the cane into the pipe until it hits the base; and
- feel the cane as it leans against the wall of the PVC pipe.

Sally's cane stand was spray painted with inexpensive dark blue spray paint. This color was in high contrast to the nearly white floors. Also, Sally's peers can easily see the stand and maneuver around it. Any color that provides good contrast between the stand and floor would work well (see Figure 3). Once all the stands are constructed (we will need five), Sally will help position each one in the various rooms and classrooms she uses throughout the day. She will review each room's layout and do a perimeter preview. The classroom door and

her stand will serve as the starting or focal point for room review.

The portable cane stand for Sally may be more than just a place to store her cane. It could serve as a stationary clue that gives her information as to where she is in her classroom. The stands will be placed in consistent locations, to the right side of each room's door. In large, open rooms such as the lunchroom, the stand will be placed near her lunch table. It is hoped that the stands will reinforce room layout, orientation in the classroom, and object-to-object relationship. Concept development (positions) will be emphasized when the teaching staff signs "beside" (American Sign Language) into Sally's hand as she enters her classroom and stores her cane "beside" the door. She will learn a new sign, reinforce her position in the room, and work towards independence—all while storing her cane.

As Sally's classrooms change, I will move the holders. Teachers who do not want the stand to remain in a certain position can

move the stand after Sally leaves their rooms. Next year she will attend different classrooms, so the stands' portability will help. As classes change and when she moves on to another building, her cane stands will go with her. As her cane lengthens, the PVC pipes can be replaced with longer ones to support the cane. However, care should be taken not to make the stands too tall. Sally would have to lift the cane too high to get it into a much taller PVC pipe.

Happy building!

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## Reference

Guth, D. A., & Reiser, J. J. (1997). Perception and the control of locomotion by blind and visually impaired pedestrians. In B. B. Blasch, W. R. Wiener, & R. L. Welsh (Eds.), *Foundations of Orientation and Mobility* (2nd ed., pp. 9–38). New York: AFB Press.

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