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Validity and Reliability of a Performance-Based Orientation and Mobility Rubric

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Validity and Reliability of a Performance-Based Orientation and Mobility Rubric

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Special Education

by

Jennifer Lynn Cmar

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ABSTRACT OF THE DISSERTATION

Validity and Reliability of a Performance-Based Orientation and Mobility Rubric

by

Jennifer Lynn Cmar

Doctor of Philosophy in Special Education

University of California, Los Angeles, 2015

Professor Connie L. Kasari, Chair

The purpose of this study was to investigate the validity and reliability of scores from a performance-based orientation and mobility (O&M) rubric in adolescents with visual impairments. The following five aims were addressed: (a) describe psychometric properties, (b) evaluate internal consistency, (c) investigate inter-rater reliability, (d) evaluate construct validity, and (e) explore O&M specialists' perceptions of acceptability and feasibility. Prior research has provided evidence of associations between O&M skills and positive post-school outcomes; however, few studies have focused on O&M for children and adolescents, and existing measures of O&M skills for this population lack validity and reliability evidence.

This study used a mixed methods design to investigate scores from a performance-based rubric using data from 47 adolescents with visual impairments from three U.S. regions. The rubric included 122 items rated on a scale of 1 to 4. The results indicated that most items had adequate psychometric properties and eight of the ten sub-scales had acceptable to good internal

consistency. Results also provided initial evidence of inter-rater reliability and some evidence of construct validity. O&M specialists' perceptions of the training session, routes, and scoring procedures were favorable, and they provided several suggestions for improvement. After further refinement and empirical testing, the performance-based O&M rubric could be a useful, valid, and reliable measure of adolescents' travel skills.

The dissertation of Jennifer Lynn Cmar is approved.

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2015

DEDICATION

For Loki.

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CHAPTER 1

Introduction

Visual impairment can have a profound impact on one's ability to get around. The impact on children's cognitive and motor development can be even greater without proper intervention, as movement without vision requires the integration of sensory information with the capacity for purposeful movement. Current estimates indicate that approximately 19 million children worldwide have visual impairments, and at least 53,000 of these children reside in the U.S. (American Printing House for the Blind [APH], 2015; World Health Organization [WHO], 2014). The profession that is concerned with assessment and instruction of individuals with visual impairments in the concepts, skills, and techniques of independent travel is referred to as orientation and mobility (O&M).

Lowenfeld (1973) indicated that blindness leads to limitations in one's (a) range and variety of experiences, (b) ability to get around, and (c) interactions with the environment. These three limitations are addressed through O&M instruction. Our current conceptualization of O&M for children with visual impairments emerged from the techniques developed to teach veterans who were blinded during World War II (Welsh, 2005a, 2005b). Techniques were adapted to be developmentally appropriate, and O&M specialists were trained in techniques appropriate for various age groups.

Despite emerging evidence that O&M skills are associated with positive post-school outcomes (Cmar, 2015; McDonnall, 2011; Wolffe & Kelly, 2011), few studies have focused on O&M for children and adolescents. Most research on the effectiveness of the long cane and its techniques has been conducted on adults with visual impairments or blindfolded university students (e.g., Bongers, Schellingerhout, van Grinsven, & Smitsman, 2002; Kim, Wall Emerson,

& Curtis, 2009; LaGrow, Blasch, & De l'Aune, 1997; Ramsey, Blasch, Kita, & Johnson, 1999; Rodgers & Wall Emerson, 2005; Wall & Ashmead, 2002). To further complicate this issue, few formal instruments exist to measure O&M skills in children and adolescents, and the available instruments lack evidence of validity and reliability. Validity can be defined as the degree of confidence that an instrument or test measures what it intends to measure, and reliability relates to how consistently the instrument measures a construct (De l'Aune, Welsh, & Williams, 2000; Massof & Rubin, 2001; Tobin & Hill, 2011). The existing validated O&M instruments are designed for use with preschool-age children (Anthony, 2004a, 2004b) and adults (e.g., De l'Aune et al., 2000).

The lack of validated O&M instruments for children and adolescents is especially concerning in light of recent federal policy initiatives. Efforts to improve educational quality in the U.S. are evident in legislation such as the *No Child Left Behind Act of 2001* (NCLB, 2002) and the *Individuals with Disabilities Education Act* (IDEA, 2004), and in the establishment of the Institute of Education Sciences in 2003. Quality of research in education has renewed focus, and educators are now required to use scientifically-based teaching practices (Ferrell, 2006; Odom et al., 2005). Despite these initiatives, many techniques, procedures, curricula, and service delivery models used in the field of visual impairment are based on little to no empirical evidence (Ferrell, 2006). The purpose of this study was to evaluate the validity and reliability of a performance-based O&M rubric with a multi-state sample of adolescents with visual impairments.

Significance

To date, the O&M profession does not have a validated instrument to measure the O&M skills of children and adolescents with visual impairments. The importance of validating such an

O&M instrument for students with visual impairments is twofold. First, the development of scientifically-based teaching practices is dependent on the validity and reliability of the measures used in research. As indicated by Thompson, Diamond, McWilliam, Snyder, and Snyder (2005), "the quality of the evidence informing practice is inherently limited by the psychometric integrity of the data being analyzed in a given study" (p. 184). Although some assessment tools have been validated for use with children and adolescents with visual impairments, none of the tools adequately address O&M domains. Second, comprehensive evaluation is required for instructional planning in O&M (Pogrund et al., 2012). IDEA requirements indicate that a child with a disability must be assessed in all disability-related areas using "technically sound" tools administered for their intended purposes in which they are valid and reliable. A technically sound tool is not available to assess O&M skills of children and adolescents.

Validation of an O&M instrument will contribute to improved quality of O&M research and practice and will advance the development of the O&M evidence base. Although the present study does not intend to develop or test an intervention, its results have the capacity to influence the development of scientifically-based teaching practices through its evaluation of the technical soundness of an instrument that can be used in future research. Furthermore, the performance-based rubric is an objective tool that O&M specialists could use to assess adolescents' O&M skills.

Aims and Hypotheses

This study used a pragmatic concurrent mixed methods design to evaluate the Cane Quest Rubric. The following five aims were addressed:

Aim 1. Describe the psychometric properties of the items on the rubric.

Aim 2. Evaluate the internal consistency of the rubric's sub-scales and examine scores by

demographic factors (i.e., age group, vision level, gender, and region).

Hypothesis 2a: Scores will not differ significantly by age group, level of vision, gender, or region.

Hypothesis 2b: Alpha coefficients will be .70 or higher for each sub-scale of the rubric.

Aim 3. Investigate inter-rater reliability by comparing O&M specialists' ratings of video examples to consensus scores (by expert raters) and by examining the reliability of ratings assigned by two or more raters.

Hypothesis 3a: O&M specialists' agreement with expert ratings will be 80% or higher.

Hypothesis 3b: Intraclass correlation coefficients for video and real-time ratings will be .70 or higher.

Aim 4. Use an exploratory approach to evaluate construct validity using scores from the Cane Quest Rubric and the Skills Checklist for Cane Quest.

Hypothesis 4a: Same-trait, different-method correlations will be stronger than different-trait, different-method correlations.

Hypothesis 4b: Different-trait, same-method correlations will be stronger than different-trait, different-method correlations.

Aim 5. Explore O&M specialists' perceptions of feasibility and acceptability of the training session, routes, and scoring procedures.

Question 5a: What feedback did O&M specialists provide regarding the rater training session?

Question 5b: How did O&M specialists perceive the routes and scoring

procedures?

Definitions of Terms

The following section includes definitions of terms used throughout the remaining chapters. Definitions of any potential ambiguous or discipline-specific terminology are provided for clarification and to promote mutual understanding.

1. Assessment: Formative process designed to inquire about and improve student learning.
2. Evaluation: Summative process of determining the value or worth of an individual or item.
3. Instrument: A tool used to measure, observe, or document data in quantitative research (Creswell, 2012).
4. Mobility: Safe navigation from one location to another (Pogrund et al., 2012).
5. Orientation: Process of using one's senses to determine their position in space (Pogrund et al., 2012).
6. Orientation and mobility: The teaching of individuals with visual impairments the concepts, skills, and techniques necessary for safe, efficient, and graceful travel under all environmental conditions (Jacobson, 2013).
7. Orientation and mobility specialist: A professional with specialized training who has completed a university training program in O&M (Pogrund et al., 2012).
8. Purposeful movement: Self-initiated, self-directed movement that facilitates knowledge of and interaction with the world (Pogrund et al., 2012).
9. Related services: Transportation, developmental, corrective, and other supportive services required for a child to benefit from special education; includes O&M (IDEA,

2004).

10. Visual impairment: An impairment in vision that, even with correction, adversely affects a child's educational performance; includes low vision and blindness (IDEA, 2004).
11. Wayfinding: Purposeful movement through an environment toward a destination (Barlow, Bentzen, & Franck, 2010).

CHAPTER 2

Review of the Literature

This literature review focuses on O&M for children and adolescents with visual impairments with an emphasis on issues related to research and assessment of this population. To add context to the topics covered in this review, the first section provides a historical overview of the education of children with visual impairments in the U.S. The second section covers present-day issues related to the education of students with disabilities, followed by a third section that focuses on issues related to the education of students with visual impairments. The fourth section provides a brief history of the O&M profession, a synthesis of research related to O&M, and a discussion of O&M assessment. The final section highlights the gap in the literature that this study addresses.

Historical Perspective

The first schools for the blind in the U.S. originated in the 1830s (Koestler, 2004). In 1866, Samuel G. Howe, a pioneer in promoting inclusive education for children who are blind, publicly recognized the shortcomings of the models used at schools for the blind: (a) graduates were not accepted in mainstream employment settings and (b) families were not accepting responsibility for the futures of their children (Koestler, 2004). The first public school class for children with visual impairments opened in 1900, itinerant services were initiated in 1943, and increasing numbers of children were educated in local schools, yet the poor post-school outcomes of graduates persisted (Koestler, 2004).

The National Agenda for the Education of Children and Youths with Visual Impairments, Including Those with Multiple Disabilities was developed by a group of professionals, consumer organizations, parents, and consumers in 1995 and revised in 2004 (Corn, Hatlen, Huebner,

Ryan, & Siller, 1995; Huebner, Merk-Adams, Stryker, & Wolffe, 2004). The *National Agenda* aimed to accomplish eight goals related to improving educational services for students with visual impairments (Corn et al., 1995; Kelley, Ward, & Griffin-Shirley, 2000). This effort influenced the formulation of the *Expanded Core Curriculum* for students with visual impairments (Hatlen, 1996, 2000). The Expanded Core Curriculum was developed to address gaps in conceptual knowledge in areas affected by vision loss (Hatlen, 1996). As shown in Table 1, the framework of the Expanded Core Curriculum includes academic skills, plus nine additional areas of instruction (Hatlen, 1996; Sapp & Hatlen, 2010).

Table 1
Description of the Nine Areas of the Expanded Core Curriculum

Area	Description
Compensatory skills	Skills, such as braille, large print, and tactile symbols, needed for independent access to the academic curriculum
Career education	Vocational skills learned by sighted children through visual observation
Independent living	Activities of daily living that are typically learned incidentally, including personal hygiene and food preparation
Orientation and mobility	Skills and concepts needed for orientation and independent movement in all environments
Recreation and leisure	Skills and concepts related to activities that sighted children learn by observation, such as rules for participating in sports
Social skills	The concepts and skills needed for appropriate social interactions, including appropriate use of facial expressions and strategies for joining a group of peers
Assistive technology	The electronic tools that provide access to information, and the skills needed to use the tools
Sensory efficiency	Skills needed to access information through visual, auditory, and tactile learning channels
Self-determination[a]	The right to make life choices without undue influence, using skills such as problem solving, choice-making, and goal-setting

Note. Adapted from "The Expanded Core Curriculum: Where we have been, where we are going, and how we can get there" by W. Sapp, and P. Hatlen, 2010, *Journal of Visual Impairment & Blindness, 104*(6), 338-348.
[a]Self-determination was added to the Expanded Core Curriculum in 2003.

Education of Children with Disabilities in the United States

A discussion of issues related to education of children with disabilities provides context to issues specific to children with visual impairments. The following section provides an overview of special education in the U.S.

Relevant Federal Laws

Federal laws, including the *Rehabilitation Act of 1973* and the *Education for All Handicapped Children Act of 1974,* shaped service provision for students with disabilities. The twentieth century began with a focus on increasing the quality of education, as evident in federal legislation such as NCLB (2002) and IDEA (2004). NCLB includes the following language about *scientifically-based research* in Section 9101(37):

> The term scientifically based research —
>
> (A) means research that involves the application of rigorous, systematic, and objective procedures to obtain reliable and valid knowledge relevant to education activities and programs; and (B) includes research that —(i) employs systematic, empirical methods that draw on observation or experiment; (ii) involves rigorous data analyses that are adequate to test the stated hypotheses and justify the general conclusions drawn; (iii) relies on measurements or observational methods that provide reliable and valid data across evaluators and observers, across multiple measurements and observations, and across studies by the same or different investigators; (iv) is evaluated using experimental or quasi-experimental designs in which individuals, entities, programs, or activities are assigned to different conditions and with appropriate controls to evaluate the effects of the condition of interest, with a preference for random-assignment experiments, or other designs to the extent that those designs contain within-condition or across-condition

> controls; (v) ensures that experimental studies are presented in sufficient detail and clarity to allow for replication or, at a minimum, offer the opportunity to build systematically on their findings; and (vi) has been accepted by a peer-reviewed journal or approved by a panel of independent experts through a comparably rigorous, objective, and scientific review. (NCLB, 2002)

The 2004 reauthorization of IDEA is aligned with the requirements of NCLB in its requirements for assessment and instruction of students with disabilities. IDEA indicates that evaluations of children with disabilities must incorporate "a variety of assessment tools and strategies to gather relevant functional, developmental, and academic information about the child" (34 C.F.R. § 300.304(b)(1)). Furthermore, a single measure or assessment tool must not be used in evaluating a child with a disability. Additional evaluation requirements listed in Section 300.304 of IDEA indicate that evaluations: (a) do not discriminate based on race or culture; (b) are administered in the child's native language or preferred communication mode; (c) are valid and reliable; and (d) are administered properly by trained individuals. IDEA also requires that assessments of children with disabilities cover all areas related to their disability; therefore, children with visual impairments must be assessed in areas of the Expanded Core Curriculum.

Prevalence of Disability

Over 39 million individuals in the U.S., or 12.6% of the population, have one or more disabilities (U.S. Census Bureau, 2014). Estimates of children with disabilities are slightly lower, as approximately 8.4% of children in the U.S. have one or more disabilities (Brault, 2012). Table 2 provides estimates of the numbers of individuals with disabilities by age group. Approximately 6,046,051 children enrolled in U.S. public schools were served under Part B of IDEA in the 2011 to 2012 academic year (U.S. Department of Education, 2014).

Table 2
Prevalence of Disability

Age Range	Estimate	%
Birth to 4[a]	153,635	0.8
5 to 17	2,900,395	5.4
18 to 64	20,460,136	10.5
65 and older	16,160,513	36.0

Note. Based on data from the 2014 American Community Survey (U.S. Census Bureau, 2014).
[a]Only includes sensory disabilities.

Issues in Special Education Research

The heterogeneous population of students with disabilities and the unique context of special education create a set of issues that challenge the traditional notion of scientific research. In fact, Odom and colleagues (2005) referred to special education research as "the hardest of the hardest-to-do science" (p. 139). IDEA (2004) designates 13 disability categories and significant variability exists within each category (Odom et al., 2005). For example, individuals identified as having visual impairments could have a range of visual conditions and additional diagnoses. This heterogeneity is further complicated by a host of contextual factors, including cultural and linguistic diversity (Odom et al., 2005). The variability of students with disabilities and numerous options for educational placement contribute to the complexities evident in this research area (Odom et al., 2005). Assessment and instruction of students with disabilities is individualized and focuses on the academic, developmental, and functional needs of individual students.

The emphasis on scientifically-based research and evidence-based practices contribute to growing concerns about special education research quality (Odom et al., 2005). Guidelines have been developed for identifying evidence-based practices in special education (e.g., Gersten et al., 2005; Horner et al., 2005). Cook and Cook (2011) provided a framework for identification of

evidence-based practices based on four elements: (a) research design, (b) research quality, (c) quantity of research, and (d) magnitude of effect. Cook and Cook (2011) emphasized the importance of practitioners considering additional factors when deciding whether or not to use evidence-based practices, such as law and policy, community and professional values, teaching styles, and student characteristics.

Issues in Research of Low Incidence Populations

Research methodologies that require large sample sizes can be difficult to use when investigating some groups of individuals with disabilities (Odom et al., 2005). These difficulties are especially evident when conducting research on low-incidence populations, such as those who have orthopedic impairments, multiple disabilities, traumatic brain injury, hearing impairments, and visual impairments. For example, the low-incidence nature of visual impairment contributes to difficulties obtaining the large samples required for many statistical analyses, including those used for instrument validation. Limited assessment tools are available for children and adolescents with visual impairments (Bowen & Ferrell, 2003), especially in areas related to the Expanded Core Curriculum, and existing measures lack evidence of validity and reliability (Tobin & Hill, 2011). The lack of appropriate tools prompts researchers and practitioners to over-use tests, which may lead to carryover effects and under- or over-estimation of skills (Bowen & Ferrell, 2003; Kamei-Hannan, 2007). Research results are difficult to generalize with the characteristic small and heterogeneous sample sizes in the visual impairment field (Kitchin & Jacobson, 1997). Accordingly, instruction is often based on tradition, anecdotal evidence, trial and error, and common sense, rather than scientific evidence (Ferrell, 2006).

Education of Children with Visual Impairments

Prevalence of Visual Impairment

Children with visual impairments are a heterogeneous, low-incidence group of individuals with disabilities. According to WHO estimates, approximately 285 million individuals worldwide have visual impairments, and 19 million of those individuals are children (WHO, 2014). Over seven million individuals of all ages in the U.S. have visual impairments, or 2.3% of the population (U.S. Census Bureau, 2014). Estimates for children are slightly lower; 0.8% of children in the U.S. have visual impairments (see Table 3 for details), and approximately 68% of these children have additional disabilities (Hatton, Schwietz, Boyer, & Rychwalski, 2007).

Table 3
Prevalence of Visual Impairment

Age Range	Estimate	%
Birth to 4	89,062	0.5
5 to 17	454,831	0.8
18 to 64	3,802,921	1.9
65 and older	2,999,479	6.7

Note. Based on data from 2014 American Community Survey (U.S. Census Bureau, 2014).

Variations in definitions used to identify individuals with visual impairments contribute to differences in the numbers of children reported by different agencies. For example, a discrepancy exists between estimates reported by the U.S. Department of Education and those reported by APH (Keller & Sight, 2009). Approximately 24,000 children with visual impairments were served in public schools under IDEA in the 2011 to 2012 school year, representing 0.4% of student enrollment (U.S. Department of Education, 2014); however, the APH federal registry reported over 53,000 children with visual impairments in 2014 (APH,

2015). Both estimates are markedly lower than the 454,831 children identified by the U.S. Census Bureau in 2014. Regardless of the definition used, visual impairment is considered a low-incidence disability in the U.S.

Visual Impairment Categories

Various definitions are used to delineate degrees of visual impairment. The WHO designated three broad categories of visual impairment: (a) moderate visual impairment, characterized by visual acuity between 20/70 and 20/200; (b) severe visual impairment, characterized by visual acuity between 20/200 and 20/400; and (c) blindness, ranging from 20/400 to no light perception (WHO, 2014). Moderate and severe visual impairment are often categorized as "low vision." According to WHO estimates, 39 million people worldwide are blind and 246 million have low vision (WHO, 2014). In the U.S., roughly 2,010,000 people are blind and 6,067,000 have low vision (Brault, 2012).

Impact of Visual Impairment on Development

The impact of congenital visual impairment on development is multifaceted. Children with visual impairments may develop some skills in a different sequence and at a different pace compared to their sighted peers (e.g., Ferrell, 2000; Hatton, Bailey, Burchinaland, & Ferrell, 1997; Pogrund, 2002; Tröster & Brambring, 1993). These developmental differences are further compounded in children with greater severity of vision loss and in children with multiple disabilities (Dale & Sonksen, 2002; Hatton et al., 1997). The impact of visual impairment as related to development of O&M skills can be discussed in terms of (a) cognitive development and (b) motor development.

Cognitive Development. Sensory input facilitates the learning of body awareness, environmental awareness, and spatial concepts (Rosen, 2010a). Infants use their vision to learn

about elements of themselves and their environments that are necessary for survival and development (Perez-Pereira & Conti-Ramsden, 1999). Sighted children often gain knowledge about the world through incidental learning, as many human behaviors and skills are acquired through visual imitation and modeling (Pogrund, 2002). Many children with congenital visual impairments use their other senses to learn about the world and may have difficulty learning behaviors and skills that are typically acquired incidentally through visual observation.

Children also develop an understanding of the world by moving through various environments (McAllister & Gray, 2007). Since most of this movement is visually directed, young children with visual impairments have difficulty developing the conceptual understanding needed for independent movement. Vision is the unifying sense that facilitates the integration of sensory perceptions into a meaningful conceptual understanding of the world (Tröster & Brambring, 1993). Tröster and Brambring (1993) indicated that, without the unifying visual feedback, "tactile, proprioceptive, kinesthetic, auditory, and olfactory sensations appear disconnected, unpredictable, and accidental" (p. 88). This non-visual sensory information differs quantitatively and qualitatively from visual feedback (Bowen & Ferrell, 2003). Children's conceptual understanding may develop in a fragmented, inconsistent, and passive manner without the additional information provided through vision (Bowen & Ferrell, 2003; Pogrund, 2002). Early movement in children with congenital blindness contributes to the development of spatial knowledge and concepts (Rosen, 2010b).

Motor Development. Motor skill development typically follows a sequential pattern; however, researchers have documented different patterns of motor development in children with congenital blindness in domains of gross motor skills, fine motor skills, and early reaching (e.g., Brambring, 2007; Ihsen, Troester, & Brambring, 2010; Levtzion-Korach, Tennenbaum,

Schnitzer, & Ornoy, 2000; Tröster & Brambring, 1993). Rosen (2010a) emphasized the importance of movement in the following statement: "for children, movement is also the natural learning medium. It is the means by which they explore the environment, learn how it functions, and interact with it" (p. 138). Vision plays an important role in children's sensorimotor development, or the combination and sensory input and motor output (Rosen, 2010a). Purposeful movement is important for motor skill development, and this self-directed, self-initiated movement allows children to explore the world and develop knowledge about what exists beyond their own bodies (Pogrund et al., 2012; Rosen 2010a).

Orientation and Mobility for Children with Visual Impairments

The importance of independent travel for children with visual impairments cannot be understated. For these children, "the inability to travel independently imposes a general limitation on personal effectiveness, regardless of the particular abilities the individual may be able to demonstrate" (Shingledecker & Foulke, 1978, p. 273). Huebner and Wiener (2005) described independent mobility as a "fundamental and enabling life skill" (p. 579). The following section provides an overview of the history of O&M, the current conceptualization of O&M services, and research related to O&M for children.

Historical Perspective

Although the use of a cane or staff by individuals who are blind goes back to antiquity, modern O&M techniques grew from the techniques developed to teach veterans who lost their vision during World War II (Bledsoe, 1997; Koestler, 2004; Wiener & Siffermann, 2010). Dr. Richard E. Hoover is considered "the father of O&M with the long cane" for his refinement of the long cane and its techniques, which were later adapted for use with children (Bledsoe, 1997; Koestler, 2004). Russell Williams, a veteran who lost his vision in the war, built upon Hoover's

work at the Hines VA Hospital and developed the sequential training methods and techniques that today's O&M instruction is based upon (Bledsoe, 1997; Welsh, 2005a, 2005b).

The 1960s marks the "birth" of the O&M profession, as the first seven university O&M training programs opened during that decade (Bledsoe, 1997; Koestler, 2004; Wiener & Siffermann, 2010). As the demand grew for teaching O&M techniques to children, university programs began including content related to teaching school-age children, preschool-age children, children with multiple disabilities, and children with low vision (Wiener & Siffermann, 2010). O&M has since become accepted as a fundamental and necessary component of education for children with visual impairments and it was designated as a related service in the 1997 reauthorization of IDEA.

Services, Domains, and Skills

Individuals with visual impairments typically use one of four methods to assist with movement: (a) long canes, (b) dog guides, (c) electronic travel aids, and (d) human guides (Hersh & Johnson, 2008; Smith & Penrod, 2010). Despite technological advances, the long cane remains the most commonly used mobility device by individuals with visual impairments due to its simplicity and durability (Smith & Penrod, 2010). The long cane extends the tactile sense by providing a preview of the environment for upcoming objects, surface changes, and surface integrity (Blasch, LaGrow, & De l'Aune, 1996; Smith & Penrod, 2010). Smith and Penrod (2010) suggested that the long cane is merely a "piece of pipe or fiberglass and will not make a person independently mobile" (p. 242) and that the importance lies in learning the strategies and techniques required to use the cane.

O&M Services. Education and rehabilitation programs for individuals with visual impairments typically include O&M services, and the professionals who teach these fundamental

travel skills are called O&M specialists. O&M services are defined in IDEA as "services provided to blind or visually impaired children by qualified personnel to enable those students to attain systematic orientation to and safe movement within their environments in school, home, and community" (34 C.F.R. § 300.34(c)(7)). O&M services typically involve one-on-one, individualized instruction to facilitate monitoring of safety in complex learning scenarios and dynamic travel environments such as busy intersections (Bina, Naimy, Fazzi, & Crouse, 2010). Children benefit from O&M services at various developmental stages, as appropriate for their maturity, ability, and needs (McAllister & Gray, 2007).

The Orientation and Mobility Severity Rating Scale (OMSRS; Michigan Department of Education, 2008a) and the Orientation and Mobility Severity Rating Scale Plus (OMSRS+; Michigan Department of Education, 2008b) are two commonly used instruments for determining optimal O&M service delivery levels. Wall Emerson and Anderson (2014) evaluated the validity of the OMSRS and OMSRS+ by comparing the measures to the professional opinion of the O&M specialist, the "gold standard" in the field. The researchers concluded that the scales are moderately valid for determining appropriate O&M service levels, and they recognized that more work needs to be done in evaluating the validity and reliability of the O&M severity rating scales (Wall Emerson & Anderson, 2014). Their work reflects progress in moving from a decision-making process based solely on professional opinion to one based on science.

Findings from the National Longitudinal Transition Study-2 (NLTS2) provided insight into O&M service provision for adolescents (Cameto & Nagle, 2007). Cameto and Nagle (2007) found that students who attended schools for the blind were more likely to receive O&M services than those in other educational settings, and that high school students with total blindness were more likely to receive O&M services than those with low vision. Results of a Delphi study

focusing on identifying O&M content appropriate for children with visual impairments suggested that experts felt that children who are blind require instruction in more O&M skills and concepts than children with low vision (Wall Emerson & Corn, 2006). Taken together, these findings suggest that O&M service provision might be influenced by factors such as school placement, level of vision, and professional judgment.

Domains of O&M Training for Children. O&M training for children with visual impairments covers a range of concepts, skills, and techniques, depending upon children's age and developmental needs (Pavey, Douglas, McLinden, & McCall, 2003). IDEA (2004) mandates instruction in the following areas, as appropriate: (a) spatial and environmental concepts; (b) use of information received by the senses to establish, maintain, or regain orientation and line of travel; (c) use of the long cane or a service animal; (d) use of remaining vision and distance low vision aids; and (e) other concepts, techniques, and tools. The exact nature of O&M instruction depends largely on the age and development of each child, and O&M specialists must consider individual differences when planning instruction (Pavey et al., 2003). Early O&M services include instruction in body awareness, spatial awareness, and social and emotional development (Pavey et al., 2003). Later O&M services include basic travel skills instruction in home and school settings, and advanced training in residential, light-business, and business environments (Hill & Ponder, 1976; Pogrund et al., 2012).

O&M Skill Development. Little research has been conducted on the development of O&M skills in children and adolescents. Ferrell (2007) emphasized the importance of developing age-appropriate O&M skills in the following statement:

> If typical peers can walk down the block to visit a friend's house, a blind child should be able to do the same. When typical peers walk to school with their friends instead of their

> parents, a blind child should be able to do the same. When typical peers drive to school or to after-school jobs, a blind teenager should be able to take public transportation or arrange a ride with others. All too often, these skills are developed later or not at all, and they can sentence a child with visual impairment to a lifetime of dependency. (pp. 4-5)

Research has not established the age at which children and adolescents with visual impairments acquire many of the skills required for independent travel, such as crossing streets (Wright & Wolery, 2014).

Researchers have used data from the National Longitudinal Transition Study-2 (NLTS2) to investigate O&M skills in a nationally representative sample of students with visual impairments (Cameto & Nagle, 2007; Cmar, 2015). NLTS2 measured O&M skills using the 10-item *Teaching Age-Appropriate Purposeful Skills* (TAPS) campus environment checklist (Pogrund et al., 1995) and three parent-reported questions related to community travel. Cameto and Nagle (2007) found that students with low vision scored significantly higher than those who are blind on campus travel skills, and students without additional disabilities scored higher than those with additional disabilities on most skills. Similarly, Cmar (2015) found that students with low vision had higher scores on both campus and community travel skills than students who are blind, regardless of whether or not they had additional disabilities.

The TAPS curriculum and the associated evaluation are commonly used in the O&M field; however, the validity and reliability of the evaluation have not been reported. Furthermore, the TAPS evaluation checklists are intended for use as an ongoing assessment to document students' acquisition of skills throughout their schooling, rather than providing an objective representation of their skills at a given point in time.

Cmar & Kamei-Hannan (2015) conducted a pilot study of community travel skills of 17

adolescents with visual impairments. Participants were rated using a performance-based rubric that was designed to provide an objective measure of O&M skills. Scores were generally high across the 10 O&M skills included in the study; however, highest means were found for residential street crossings with light to moderate traffic and cane technique (measured at an indoor mall). The lowest and most variable scores were found for street crossings (with moderate/heavy traffic) in a business area.

O&M Assessment

Purpose. Assessment data guide decisions about the frequency, duration, and appropriateness of O&M services (Fazzi & Naimy, 2010). The purposes of assessment for children with visual impairments include (a) establishing baseline, (b) tracking progress, (c) identifying priorities, and (d) planning instruction (Best, 1987). O&M assessment should be undertaken upon initial identification of visual impairment (Douglas, Pavey, McLinden, & McCall, 2003; Fazzi & Naimy, 2010). Other factors precipitating a need for O&M assessment include: (a) a sudden change in visual impairment, (b) beginning a new school, and (c) transitioning between schools (Douglas et al., 2003).

Considerations. Selection of an assessment tool for children with visual impairments should involve consideration of six elements: (a) the format of the content and scoring procedures, (b) the nature of the items, (c) the theoretical underpinnings of the sub-scales, (d) the developmental range of the items, (e) suitability for children who are blind or have low vision, and (f) the process used to develop the measure (Best, 1987). When evaluating construction of a measure, one must consider the authors' credentials, the supporting research base, and available evidence of validity and reliability (Best, 1987). An additional consideration for O&M assessments is the inclusion of a performance-based component that incorporates observations of

students' performance of everyday tasks in indoor and outdoor environments (Bina et al., 2010).

In reality, visual impairment professionals may base their choices of assessment tools on a different set of criteria. Kamei-Hannan (2007) found that the choice of a tool may be based on the need to (a) measure performance based on a grade level or continuum of skills, (b) present an overall "picture" of students' performance, (c) locate a test in the appropriate literacy medium, (d) determine students' educational needs, (e) show annual progress, (f) transfer scores to another school, and (g) use a test that "works" for children with visual impairments. Progress monitoring and assessment depend on the accuracy of information recorded during an assessment and the sensitivity of the scales to small changes in behavior (Best, 1988).

Issues. The heterogeneity of the population of children with visual impairments contributes to difficulties validating assessment tools (Tobin & Hill, 2011; Wall Emerson & De l'Aune, 2010). Assessment difficulties related to the variability of the population, such as the range of visual ability and age of onset of blindness, have been recognized since the 1940s (Koestler, 2004). Many assessments of students with visual impairments rely on subjective evaluations of skills based on anecdotal observations or teacher-created checklists. The limited availability of assessment tools may force practitioners to base decisions on whatever test scores are available. Tobin and Hill (2011) cautioned against making important educational decisions based on a single assessment score, a sentiment that was echoed by teachers of students with visual impairments. Kamei-Hannan (2007) found that teachers, administrators, and school psychologists commonly chose tests, and few teachers used a combination of assessment tools to evaluate student performance.

Development. Shingledecker and Foulke (1978) outlined four levels to consider when creating O&M assessments: (a) the nature of the data, (b) the purpose of the assessment, (c) the

approach used, and (d) the assessment setting. The following sections contain a discussion of relevant research and related issues surrounding each level.

Nature of Data. Shingledecker and Foulke (1978) indicated that mobility assessment data could be subjective or objective. Assessment data used to make training decisions may be observational, interpersonal, or clinical (Dodds, Beggs, & Clark-Carter, 1986). Dodds and colleagues (1986) observed the subjective nature of O&M specialists' ratings in their study where O&M specialists ranked individuals with visual impairments by skill based on a video. The results indicated that O&M specialists working together as a team had high disagreement in their ratings, which indicated that the O&M specialists used different criteria or weighted skills differently in assessing performance. Furthermore, the O&M specialists (a) demonstrated little agreement in perceived importance of age, visual acuity, visual field, confidence, and motivation; and (b) prioritized the needs of students in different (and sometimes opposite ways).

Purpose of Assessment. Assessment data are often used to make high-stakes decisions about the frequency, duration, and appropriateness of O&M services (Fazzi & Naimy, 2010). Purposes of O&M assessments can range from evaluation of a specific device to a global evaluation of a student's skills (Shingledecker & Foulke, 1978). O&M assessment is used to determine a need for services, establish present levels of performance, monitor achievement of goals, and evaluate the effectiveness of instruction (Bina et al., 2010). Furthermore, assessments can identify students' strengths and needs, and determine priorities for instruction (Pogrund et al., 2012).

Approach. According to Shingledecker and Foulke (1978), O&M assessment may be based on a sub-skill or whole task approach. Zebehazy, Zimmerman, and Fox (2005) used digital video as a tool for improving and assessing observational skills of O&M students in university

programs to assess the observational skills of O&M students before they were required to observe skills in real time. Using a sub-skill approach, the researchers created three 2-minute long video clips, with skills performed by sighted researchers who made deliberate errors. O&M students and O&M specialists identified "textbook" errors at similar rates, and they viewed each video clip three times on average. Wright and Wolery (2014) also used a sub-skill approach to evaluate adolescents' street crossings based on the following steps: (a) finding the curb with the cane, (b) stepping up to it, (c) lining up for the crossing (perpendicular to the traffic), (d) taking one step back, (e) sweeping the area in front of the feet with the cane, (f) holding the cane in the "ready position" (diagonally across the body), (g) describing the parallel and perpendicular traffic and how each was controlled, (h) identifying a sufficient gap in traffic for the crossing, (i) walking quickly, (j) walking without veering left or right, (k) finding the opposite curb, and (l) stepping out of the street.

Setting. A final consideration is the assessment setting, which may range from a laboratory to a real-world environment (Shingledecker & Foulke, 1978). Kitchin and Jacobson (1997) found that most studies focusing on O&M, wayfinding, or spatial ability were conducted in "microscale" environments, including small spaces, short routes, and corridors of buildings. The researchers asserted, "wayfinding in large-scale real-world spaces is different from wayfinding in limited areas" (Kitchin & Jacobson, 1997, p. 10). These limited environments represent a small subset of typical travel scenarios, and performance in these types of areas may not generalize to everyday performance in real-world settings (Kitchin & Jacobson, 1997). Finally, Kitchin and Jacobson (1997) indicated that research should focus on assessing ability and knowledge in real, complex environments, rather than inferring that laboratory findings will transfer to real-world settings.

O&M assessment in real-world settings is also associated with disadvantages (Shingledecker & Foulke, 1978). First, opportunities for performance of behaviors are a function of the environment and cannot be manipulated easily. Second, some behaviors cannot be observed due to high risks (e.g., crossing a street at the wrong time). Third, extraneous variables, such as noise, weather, and traffic, cannot be controlled.

Existing Measures. O&M assessments typically involve the use of checklists, interviews, or observations using subjective, informal instruments. Few formal instruments exist to assess O&M skills (see Table 4), and most are intended for use with young children or adults. The instruments that are appropriate for children and adolescents either (a) lack a research foundation or (b) contain many domains beyond the scope of O&M.

Table 4
Existing Instruments for Orientation and Mobility Assessment

Instrument	Format	Population	Ages	Domains
Vineland Adaptive Behavior Scales	Semi-structured interview with adult	Includes VI	Birth to 90	Communication Daily Living Skills Socialization Motor Skills
Functional Independence Measure	7-point Likert-type scale based on self-report and task performance (50 items total)	Individuals with physical disabilities; adapted for blindness	Veterans	Visual Skills Orientation and Mobility Daily Living Skills Manual Skills
Functional Assessment Battery	5-point Likert-type scale based on self-report (26 items) and task performance (21 items)	Individuals with Retinitis Pigmentosa	14-77	Reading Mobility Peripheral Detection
Patient-based Assessment of Mobility Difficulty	5-point Likert-type scale (35 questions)	Individuals with glaucoma and Retinitis Pigmentosa	27-80	Difficulty Performing Mobility Tasks
Teaching Age-Appropriate Purposeful	Functional Mobility Tasks rated on a 3-point	Children with Visual Impairments,	3-21	Home/Living Environment Campus

Skills 3rd Edition Comprehensive Initial and Ongoing Evaluation	scale (Emerging, Competence, Generalized) and Checklist rated with + or -	including those with Additional Disabilities		Environment Residential Environment Commercial Environment Public Transportation Ambulatory Devices
Inventory of Purposeful Movement Behaviors	117 items, rated with + or -, includes age equivalents in months	Young Children with Visual Impairments	Birth to 3	Purposeful movement
O&M Assessment: Early Years of Birth through 3 Years	Items, rated with + or -, includes age equivalents in months	Young Children with Visual Impairments	Birth to 3	Visual Development Auditory Development Tactile Development Conceptual Knowledge of Self, Others, and Objects Environmental Awareness Social/Emotional Development Communication Motor Skills

The physical therapy field has several examples of performance-based assessments of balance, mobility, and motor skills that have been validated in children, adolescents, and young adults with low-incidence disabilities (e.g., Moody, Wright, Brewer, & Geisler, 2007; Tedla, Ganesan, & Katragadda, 2009; Williams, Greenwood, Robertson, Goldie, & Morris, 2006; Wright, Ryan, & Brewer, 2010). Validity and reliability studies of these measures commonly used a Classical Test Theory approach, with sample sizes as small as 8 and 21 (e.g., Moody et al., 2007; Tedla et al., 2009). Small sample sizes prohibited the use of the most sophisticated analyses in many of these studies; however, results provided evidence of validity and reliability.

Of these assessments, the Community Mobility Assessment appears to be most applicable to O&M in community settings, as this observational measure was developed to assess physical and cognitive skills of adolescents with acquired brain injury in real-life settings (Moody et al., 2007). Moody and colleagues (2007) evaluated preliminary inter-rater reliability at one site during a 2-hour community outing, and planned to use a multi-site sample to gather evidence of construct validity. These examples from the physical therapy literature outline methodologies that have been used to validate performance-based assessments in low-incidence populations.

Purpose of the Study

The need for validated O&M assessments for children and adolescents with visual impairments has been evident for many years (Dodds et al., 1986; Shingledecker & Foulke; 1978; Turano, Massof, & Quigley, 2002; Zebehazy et al., 2005). The importance of objective O&M measures is exemplified in the following quotation:

> It is clearly unsatisfactory that the assessment which a client receives should be as much dependent upon who is carrying out the assessment as it is upon the client's actual status. We would argue that the only way to approach this problem is to make explicit the criteria involved in assessment, and to develop more objective approaches. (Dodds et al., 1986, p. 57)

The current study builds on prior research by investigating the validity and reliability of a revised version of the scoring rubric used by Cmar & Kamei-Hannan (2015) using a larger and more geographically diverse sample. Specifically, the purpose of this study is to evaluate the internal consistency, inter-rater reliability, construct validity, and acceptability of a performance-based rubric designed to measure the O&M skills of adolescents with visual impairments.

CHAPTER 3

Method

This chapter begins with a description of the current study, including its research design, setting, participants, and procedures. The study's measures and data collection procedures are described next. The chapter concludes with a description of the methods used for data analysis for each of the study's five aims.

Research Design

This study used a pragmatic concurrent mixed methods design (Creswell, 2003; Johnson & Onwuegbuzie, 2004) to examine the validity and reliability of a performance-based O&M rubric. This study fits within the pragmatic philosophical perspective, which is often used in mixed methods research that takes place in naturalistic settings and uses non-experimental designs. Pragmatists emphasize informing practice through research focusing on real-world problems.

Mixed methods research is a "class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study" (Johnson & Onwuegbuzie, 2004, p. 17). A mixed methods design was chosen to (a) improve the rubric and maximize its utility, (b) evaluate acceptability of the rubric, and (c) enhance the interpretation of the results (Collins, Onwuegbuzie, & Sutton, 2006). The purposes of mixing methods are for complementary and expansion reasons, as the qualitative data add depth and meaning to the quantitative data. This study uses a concurrent design because the quantitative and qualitative data were collected simultaneously during Cane Quest and data analysis was conducted after all data were collected (Collins et al., 2006). The qualitative and quantitative data were unequally prioritized in this study, leading to a QUAN+qual design

(Hanson, Creswell, Plano Clark, Petska, & Creswell, 2005; Johnson & Onwuegbuzie, 2004). The quantitative data were prioritized because the data collection instruments consisted of predominantly pre-determined closed-ended questions with a discrete set of responses with data primarily recorded in numeric format (Creswell, 2003), and the qualitative data played a supportive role in this study. The integration of quantitative and qualitative methods is evident in (a) the use of common participants in the data collection stage, and (b) the data interpretation stage.

Setting

Data were obtained from an annual O&M program called Cane Quest. Developed by Braille Institute of America, Inc., Cane Quest is a national competition that tests children and adolescents with visual impairments in the skills required to navigate the world around them independently and safely (Braille Institute of America, Inc., 2014). The contest rules are included in Appendix A. Data were analyzed from three sites in the West Pacific, South Atlantic, and West South Atlantic U.S. Table 5 provides additional information about the regional sites where each route was located.

Table 5
Characteristics of Regional Sites

Site	Region	Division	Population[a]	Total Housing Units[a]	% Urban[b]	% Rural[b]	Median Household Income[a]
CA	West	Pacific	63,000	19,000	100	0	48,000
FL	South	South Atlantic	16,000	8,000	100	0	26,000
OK	South	West South Central	18,000	8,000	76	24	29,000

[a]Based on data from 2013 American Community Survey.
[b]Based on 2010 Census data.

Participants

Sampling

This study employed a multi-level mixed methods sampling strategy, as data were nested within three regions (Teddlie & Yu, 2007). A complete collection (criterion) sampling strategy was used to identify individuals who participated in Cane Quest during the specified time frame, and data from one or more regions were used to address each of the study's aims.

Recruitment

Regional coordinators at each site oversaw recruitment of participants. To identify potential participants, regional coordinators contacted school districts, O&M specialists, teachers of students with visual impairments, and families in their region. The numbers and percentages of participants from each of the three regions are provided in Table 6.

Table 6
Numbers and Percentages of Participants by Site

Site	*n*	%
Oklahoma	8	17
Florida	8	17
California	31	66

Inclusion Criteria

Cane Quest participation criteria included: (a) in Grades 7-12, (b) receiving O&M services, (c) diagnosis of a moderate or severe visual impairment, (d) use a long cane for travel, (e) ability to follow detailed auditory instructions, and (f) ability to walk for at least an hour at a time. Participants were required to have a completed Parent Permission Form (Appendix B) and Contest Application Form (Appendix C) on file. Participants were grouped according to their grade level and vision category. *Explorers* were in grades 7-9 and *Trailblazers* were in grades 10-12. Vision categories followed the guidelines set forth by The United States Association of

Blind Athletes (n.d.). Category *B1* is defined as "no light perception in either eye up to light perception, but inability to recognize the shape of a hand at any distance or in any direction." Category *B2* is defined as "from ability to recognize the shape of a hand up to visual acuity of 20/600 and/or a visual field of less than 5 degrees in the best eye with the best practical eye correction."

Participants ranged in age from 12 to 20 years old (M = 15.6, SD = 2.12), and most participants were blind (i.e., vision category B1). See Table 7 for additional demographic information.

Table 7
Demographic Information for Participants

Variable	Frequency	%
Group		
Explorer	19	40
Trailblazer	28	60
Vision		
Blind (B1)	32	68
Low vision (B2)	15	32
Gender		
Male	21	45
Female	26	55
Age		
12	4	9
13	5	11
14	7	15
15	6	13
16	7	15
17	8	17
18	8	17
20	2	
Grade		
5	1	2
7	5	11
8	8	17
9	5	11
10	9	19
11	10	21
12	9	19

Note. Permission was granted for a 12 year old 5th grader to participate.

Procedure

Route Development

Route development began approximately three months prior to each event. Routes were developed by or in collaboration with Braille Institute using video and/or web-based mapping applications. Routes took place in community settings and were designed for completion in 60 to 90 minutes. Routes included opportunities for participants to demonstrate specific skills, and checkpoints (areas along a route where raters were stationed) were matched to corresponding locations along the routes. As specified in Table 8, a core group of 11 skills were included at each site. Inclusion of the remaining skills depended on regional characteristics and resources. Routes were pilot-tested by adult volunteers with visual impairments approximately two months before each event and changes were made accordingly.

Training

Prior to each event, training sessions were conducted for raters, volunteers, and participants using specified training materials (see Appendix D for an overview of the training materials). Shadows completed a training session where they learned their roles and responsibilities for monitoring safety during the routes. Participants learned the rules of the event and received training on basic operation of the BookPort digital media player. O&M specialists serving as raters completed a 90-minute training session where they learned scoring procedures. During the training session, raters watched video examples of travelers performing skills from the rubric and they marked their ratings on a scoring sheet. After all raters scored each item, a brief discussion took place to clarify any scoring discrepancies.

Table 8
Overview of Rubric Content

Skill	Description	Items	Sub-skill Example
*Touch/Constant Contact Cane Techniques	Basic techniques for using the long cane	10	Wrist movement
*Touch and Drag/3 Point Touch Cane Techniques	Additional techniques for using the long cane	9	Maintain appropriate distance to shoreline
*Residential Street Crossings	Sequence of skills for crossing residential streets	9	Crosses at appropriate time
*Pedestrian Button Intersections	Sequence of skills for crossing lighted intersections	11	Maintain line of travel while crossing
*Alley/Business Driveways	Sequence of skills for crossing alleyways and business driveways	4	Detect alleyway or driveway with cane and stop and listen for traffic
*Negotiating Obstacles	Skills for detecting and maneuvering around obstacles	4	Moves around obstacle
Car Detection	Skills for detecting and maneuvering around parked vehicles	5	Detects and identifies car in line of travel
*Stairs Down/Up	Sequence of skills for ascending and descending stairs	12	Proper cane position when descending stairs
Escalators	Sequence of skills for locating, boarding, and exiting escalators	8	Approach edge of platform
*Doors with Door Knobs or Handles	Skills for contacting, opening, traversing through, and closing doors	6	Contacts the door with cane
Seeks Assistance	Strategies and techniques for soliciting assistance from the public	6	Asks appropriate questions
Bus Travel	Skills and techniques for using public buses	10	Locates bus stop
*Human Guide	Skills for traveling with a human guide	7	Demonstrates changing sides
Care of Cane	Basic concepts and skills related to the long cane	5	Parts of the cane
*Orientation Questions	Conceptual knowledge related to traffic patterns	8	Identify parallel traffic
*Cardinal Directions	Concepts and skills for using cardinal directions	8	Turns to North

Note. *Skills that were included at all sites.

Route Instructions

Participants used a BookPort digital media player to listen to auditory route instructions. The following example illustrates the nature of the auditory instructions:

1. Start mid-block on the west side of the street.
2. Line up facing north.
3. Walk straight ahead, north, to the corner.
4. At the corner, turn east, and cross the street. This is an accessible signal intersection.
5. After crossing the street, continue walking east to the corner.

Participants were encouraged to preview the instructions before beginning and as needed during the routes. The route instructions guided participants through typical travel scenarios that are commonly found in residential, light business, and business environments. For example, part of the route involved walking on a sidewalk in a residential neighborhood, where participants might encounter vehicles parked on the sidewalk, overhanging tree branches, and uneven terrain.

Measures

Four measures were used to evaluate the validity, reliability, and acceptability of the Cane Quest Rubric: (a) raters' training scores, (b) the Skills Checklist for Cane Quest, (c) the Cane Quest Rubric, and (d) an Evaluation Form completed by raters. The following section provides additional information about each measure.

O&M Training Scores

O&M specialists who rated participants completed a mandatory morning training session. During the training session, raters were introduced to scoring procedures and they completed a form (included in Appendix E) throughout the training as they rated students performing skills in

video examples. The form included a selection of items from the rubric, in the order presented in the video. Each section included a place to mark scores for two video examples per skill.

Skills Checklist for Cane Quest

Each participant's O&M specialist completed the Skills Checklist for Cane Quest prior to the contest. The skills checklist, which covered the basic set of skills needed for successful participation in Cane Quest, documented students' O&M skill levels from the perspective of each student's O&M specialist. The checklist is part of the Contest Application form (included in Appendix C). The skills checklist contains 37 items, such as *cross residential streets*. Checklist items are similar in scope to those on the rubric. Items were rated on a 4-point Likert-type scale, with a score of 1 representing *poor* and a score of 4 representing *excellent*. Participation in Cane Quest did not require mastery of all skills; however, familiarity with the skills was recommended.

Cane Quest Rubric

The Cane Quest Rubric (see Appendix F) was designed to provide an objective tool for measuring adolescents' O&M skills. O&M specialists from Braille Institute of America, Inc. developed the rubric in collaboration with subject matter experts from California State University, Los Angeles. The rubric was created for Cane Quest to provide criteria for O&M specialists to use when scoring participants, and it was the primary measure used to document participants' skills during the competition. The following sections cover the rubric's development, content, and scoring procedures.

Development. The Cane Quest Rubric was developed in 2011 by a team of experts in the field of O&M. A search of the available instruments revealed that existing measures lacked the specificity required for Cane Quest. Initial item generation was based on a review of the O&M

literature, including textbooks, publications, and existing measures. The first version of the rubric had five sub-scales and a total of 33 items. The rubric was pilot tested at the inaugural Cane Quest event in Spring 2011. Since then, the rubric has been revised annually based on feedback from stakeholders, including O&M specialists and Cane Quest participants.

Content. The rubric includes a selection of O&M skills that participants are asked to demonstrate during Cane Quest. Skills are intended to be age-appropriate for middle school and high school students who have visual impairments. The rubric has 16 sections, each of which represents a broad O&M skill. Each section includes 4 to 12 items, for a total of 122 items. The content of the rubric is summarized in Table 8.

Scoring. Each item is scored on a 4-point scale. A "4" represents the highest possible score for each skill, and a "1" represents the lowest possible score or the absence of a skill. Scoring guidelines for individual items are embedded into the rubric, as shown in the following example:

21. Locates the down curb using cane

1 = Traveler oversteps the curb or wheelchair ramp

2 = Traveler stops short of the corner without the cane making contact with the curb or the lip of the wheelchair ramp

3 = Traveler does not maintain full cane arc but locates curb

4 = Traveler maintains full cane arc to down curb

O&M Evaluation Form

The O&M Evaluation Form was used to document feedback from the O&M specialists who rated participants during Cane Quest. The measure included seven multiple-choice questions and five open-ended questions, covering three sections: (a) training, (b) routes and

scoring, and (c) additional comments/suggestions. The multiple-choice questions were rated on a 5-point Likert-type scale. Responses were collected anonymously; the form did not include identifying information. Before dissemination, a committee reviewed the measure and it was revised according to feedback. A copy of the measure is included in Appendix G.

Data Collection

During each event, raters were stationed at designated points along the route where they scored participants for their assigned section of the rubric. Participants completed the routes at their own pace, but were asked to pause at times to make sure that they did not reach a checkpoint at the same time as another participant. This process allowed raters to score each participant individually. Raters circled their scores directly on the rubric, which has plenty of white space where raters could write comments or notes about participants' performance, rubric content, and/or conditions affecting implementation. After all participants completed the route, scores were compiled into an Excel spreadsheet and contest winners were determined based on the highest scores for each group. At one site, an additional two raters independently scored a sample of skills. These extra raters moved from checkpoint to checkpoint in the opposite direction of travel of the participants, which facilitated scoring a variety of participants and raters.

Data Analysis

Aim 1

The first aim of this study was to describe the psychometric properties of the Cane Quest Rubric at the item level. Variables were examined to check for invalid and missing values and for items with a large percentage of missing values. Frequencies of values were examined and highly unbalanced items (i.e., > 95% of participants had the same score) were considered for

removal (Clark & Watson, 1995). Means and standard deviations were calculated for each item. The most useful items have higher variability of scores and a mean near the center of the distribution (Kline, 2005).

The researcher also transcribed written notes from each section of the rubric. Notes were organized into an Excel spreadsheet, along with contextual information about the note, such as the sub-scale of the rubric, item (as applicable), and contestant number. The notes were grouped by sub-scale and examined qualitatively for common themes. Findings were used to aid in interpretation of the quantitative results.

Aim 2

The second aim of this study was to evaluate the internal consistency of the rubric's sub-scales, and to examine composite scores by demographic variables. Cronbach's alpha was used to evaluate internal consistency of the items in each sub-scale (Cronbach, 1951). Alpha can be interpreted as the percent of variance that the scale would explain in a "hypothetical true scale" with all possible items in the universe; an alpha coefficient of zero signifies only error and an alpha coefficient of one signifies measurement of the true score (Garson, 2013). Alpha is sample-dependent, and reliability estimates may differ depending on the heterogeneity of a given sample (Streiner, 2003).

Final sub-scales were developed using an iterative process. Initial alpha coefficients were calculated using all items from each section of the rubric, and inter-item correlations and item-total statistics were examined. The following factors were considered when assessing items for removal from a sub-scale: (a) the mean inter-item correlation, (b) the range of inter-item correlations, (c) the item-total correlations, and (d) the change in alpha after deleting the item. According to Clark & Watson (1995), the mean inter-item correlation should range from .15 to

.50, and ideally, all individual inter-item correlations should also fall between .15 and .50. Furthermore, the item-total correlations for "good" items should be at least .30 (Nunnally & Bernstein, 1994). If the alpha coefficient increases after deleting an item, that item should be considered for removal from the sub-scale. Items with low item-total correlations were deleted sequentially and the analysis was re-run and re-evaluated for each sub-scale. Criteria in Table 9 were used to interpret the final alpha coefficients.

Table 9
Criteria for Interpreting Alpha Coefficients

Value	Interpretation
> .90	Excellent
> .80	Good
> .70	Acceptable
> .60	Questionable
> .50	Poor
< .50	Unacceptable

Note. Criteria obtained from George and Mallery (2003).

Items were combined to form composite variables for each sub-scale of the rubric by calculating the mean score of the items in the section. As portrayed in Figure 1, the sub-scales were grouped into two broader scales. Descriptive statistics were generated for the composite variables to examine distributions, means, random error, and variability of the scores. Sub-scales were examined by demographic factors (i.e., age group, level of vision, gender, and region) to determine if any items differed based on these variables.

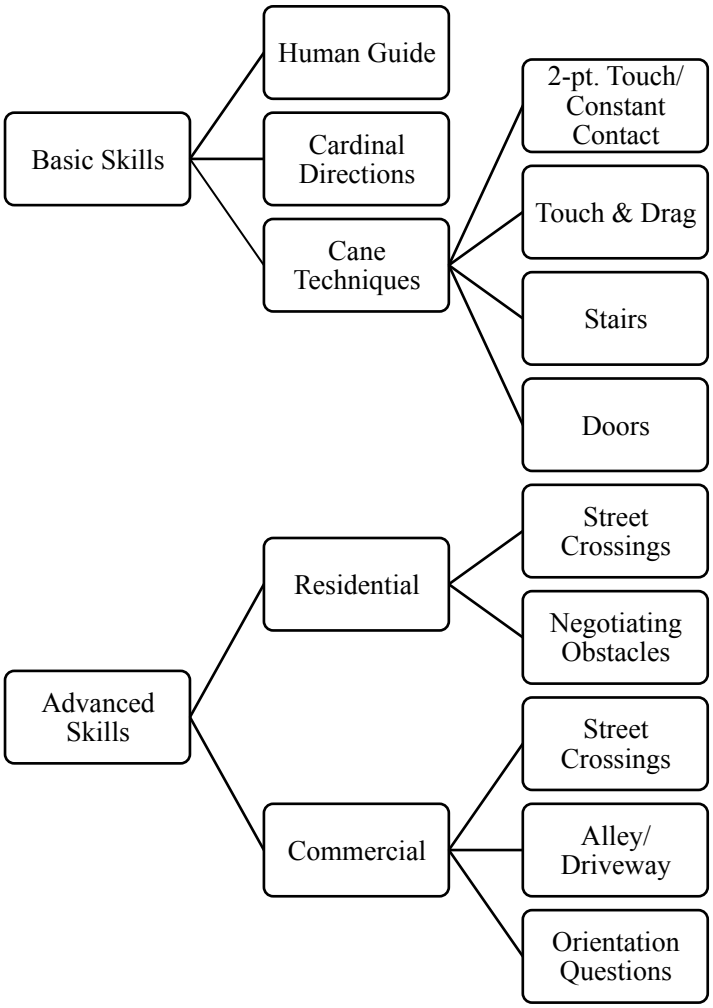


Figure 1. Diagram showing division of the rubric's sub-scales into basic and advanced skills.

Aim 3

The third aim of this study was to investigate inter-rater reliability of the rubric. Inter-rater reliability measures homogeneity across raters by having two or more raters administer a test to the same people (Garson, 2013). This study incorporated video examples and real-time ratings to estimate inter-rater reliability.

The first method was based on video examples of a selection of items, using a fully crossed design where multiple raters scored the same video examples (Hallgren, 2012). O&M specialists' ratings of video examples were compared to pre-established expert ratings based on

consensus scores of a panel of O&M specialists. Percent agreement was calculated by dividing the number of exact agreements with the expert ratings by the total number of raters and then multiplying by 100. Furthermore, intraclass correlation coefficients (ICC) were used to evaluate inter-rater agreement for the 13 video examples using a two-way, random effects, absolute model [ICC(2,1); Shrout & Fleiss, 1979].

The second method took place in real-time, where two raters scored a subset of participants on a selection of items and a single rater scored the remaining participants. This design was not fully crossed, as different pairs of raters scored different participants (Hallgren, 2012). Intraclass correlation coefficients were calculated using a one-way absolute model [ICC(1,1)] to estimate inter-rater reliability based on the extent to which two independent raters consistently scored participants. Separate ICC(1,1) values were computed for item and sub-scale scores. Criteria provided by Cicchetti (1994) were used to establish acceptable ICC values: (a) < .40 is poor, (b) .40 to .59 is fair, (c) .60 to .74 is good, and (d) .75 to 1.0 is excellent.

Aim 4

The fourth aim of this study was to use an exploratory multitrait-multimethod (MTMM) matrix (Campbell & Fiske, 1959) to evaluate construct validity using scores from the Cane Quest Rubric and the Skills Checklist for Cane Quest. Since another validated measure of the same constructs is not currently available, the professional opinion of the O&M specialist (as indicated on the skills checklist) is arguably the "gold standard" for assessing O&M skills. Items were selected from the Skills Checklist and matched with sub-scales from the rubric based on their conceptual similarities (see Table 10). The Skills Checklist items were combined into two composite variables corresponding with two broad scales of the rubric.

Table 10
Alignment of Rubric Composite Variables and Skills Checklist Items

Scale	Rubric Sub-scale	Skills Checklist Item
Basic	Human Guide	HG (Human Guide)
	Cardinal Directions	DIR (Cardinal Directions)
	Touch/Constant Contact/Congested Area Cane Techniques	TOUCH (Two Point Touch Technique) CONST (Constant Contact Technique)
	Touch and Drag	DRAG (Touch and Drag Technique)
	Stairs Down/Up	STAIRS (Locate, approach, ascend, and descend stairs)
	Doors with Door Knobs or Handles	N/A
Advanced	Quiet Residential	RES (Cross residential streets)
	Crossing/Moderate Parallel	CLOCK (Cross in a clockwise direction)
	Crossing/Heavy Parallel Crossing	COUNT (Cross in a counter-clockwise direction) REP (Reposition self on sidewalk and walk in desired direction)
	Negotiating Obstacles	OBST_RES (Move around obstacles in residential area) OBST_BUS (Negotiate obstacles in business area)
	Pedestrian Button Intersections - Light/Moderate/Heavy Signal Crossings	ACC (Cross at accessible signals) SIGN (Cross at signal intersections parallel to a major street) MAJ (Cross major signal intersections with left turn signals
	Business Driveways/Alleys	N/A
	Orientation Questions	PATT (Traffic patterns) LAY (Identify street layouts)

Pearson product-moment correlations were conducted to investigate linear relationships between the two rubric scales and the two skills checklist scales. The correlation coefficients were arranged into an MTMM matrix with two methods and two traits to examine evidence of convergent and discriminant validity. The MTMM matrix was evaluated using the following criteria, as established by Campbell and Fiske (1959):

1. The coefficients in the validity diagonal (i.e., monotrait-heteromethod values) should be large and statistically significant.

2. Each coefficient in the validity diagonal should be higher than those in the same row and column (i.e., heterotrait-heteromethod triangles).
3. The coefficients in the validity diagonal should be higher than the off-diagonal coefficients within the mono-method blocks.
4. A similar pattern of correlations should be found within the heterotrait triangles.

The first item was used to evaluate convergent validity and the last three items were used to evaluate discriminant validity.

Aim 5

The final aim of this study was to explore O&M specialists' perceptions of feasibility and acceptability of the training session, routes, and scoring procedures. The seven quantitative items were examined descriptively through calculation of frequencies and percentages of responses to each item. The five open-ended items were analyzed qualitatively. The researcher transcribed the responses and used open coding for data reduction and to conceptually describe the data. While reading through the data, the researcher made notes in the margins and developed a preliminary list of emerging codes. Based on this list, the researcher applied the codes to the data, refined the codes, and developed new codes for themes that did not fit into the initial coding scheme. The final codes were grouped into broader categories in alignment with the research questions.

CHAPTER 4

Results

Aim 1

Psychometric Properties of the Rubric

The rubric included 122 items divided into 16 sections. Complete data were obtained for 84% (n = 4,790) of all values. Missing values were most commonly found for skills that were not included at one or more sites. Written comments were made on the rubric by 65% (n = 28) of the 43 raters. Results in the following section are presented according to each section of the rubric.

Cane Technique 1. The 10-item Cane Technique 1 section of the rubric was completed by 45 participants. All items included the full range of values (i.e., 1, 2, 3, and 4). Item 9 (Straight line of travel) had the highest mean at 3.40 (SD = .75). Item 8 (In step) had the lowest mean at 2.33 (SD = 1.17). Items, means, standard errors, and standard deviations are provided in Table 11.

Table 11
Descriptive Statistics for Cane Technique 1 Items

Item	*M*	*SE*	*SD*
1. Arm position	3.16	.16	1.07
2. Hand position	2.91	.12	.82
3. Grip	3.20	.13	.84
4. Wrist movement	3.18	.14	.91
5. Arc width	2.96	.16	1.04
6. Arc height	3.07	.15	1.00
7. Rhythm and pace	3.22	.13	.85
8. In step	2.33	.17	1.17
9. Straight line of travel	3.40	.11	.75
10. Proper technique for area	3.31	.18	1.18

Note. n = 45.

The qualitative comments indicated that several participants did not use the specified cane technique most or all of the time. When instructed to use the two-point touch technique,

some participants elected to use the constant contact or touch and drag technique. Item 10 (Proper technique for area) was not scored at two of the checkpoints. Raters reported that this item was not applicable because the audio instructions specified the technique to use in each area.

Cane Technique 2. The 9-item Cane Technique 2 section of the rubric was completed by 43 participants. All items included the full range of values (i.e., 1, 2, 3, and 4). Item 13 (Grip) had the highest mean at 3.50 (*SD* = .88), and Item 17 (In step) had the lowest mean at 2.40 (*SD* = 1.14). See Table 12 for items, means, standard errors, and standard deviations. Raters did not provide any written comments for this section.

Table 12
Descriptive Statistics for Cane Technique 2 Items

Item	*M*	*SE*	*SD*
11. Arm position	3.36	.12	.76
12. Hand position	2.90	.14	.89
13. Grip	3.50	.14	.88
14. Wrist movement	3.09	.16	1.04
15. Arc width	2.91	.17	1.13
16. Rhythm and pace	3.23	.16	1.02
17. In step	2.40	.17	1.14
18. Maintain appropriate distance to shoreline	2.98	.18	1.16
19. Touch and drag	2.95	.14	.90

Note. $n = 43$.

Residential Crossings. The 9-item Residential Crossings section of the rubric was completed by 45 participants. All items included the full range of values (i.e., 1, 2, 3, and 4). As shown in Table 13, Item 20 (Maintain line of travel to locate curb) had the highest mean at 3.42 (*SD* = .84). Item 24 (Sweep with cane to signal start of crossing) had the lowest mean at 2.79 (*SD* = 1.28). The written comments indicated that several participants stood too far away from the curb as they prepared to cross the street.

Table 13
Descriptive Statistics for Residential Crossings Items

Item	*M*	*SE*	*SD*
20. Maintain line of travel to locate curb	3.42	.13	.84
21. Locates the down curb using cane	3.16	.16	1.04
22. Appropriate position at curb	2.84	.17	1.11
23. Appropriate stance at curb	2.96	.17	1.11
24. Sweep with cane to signal start of crossing	2.79	.20	1.28
25. Crosses at appropriate time	3.38	.17	1.13
26. Maintain line of travel while crossing	3.36	.14	.93
27. Locates opposite curb, clears, and steps onto curb	3.24	.12	.77
28. Locates sidewalk and resumes travel	3.20	.16	1.09

Note. $n = 45$.

Lighted Crossings. The 11-item Lighted Crossings section of the rubric was completed by 43 participants. All items included the full range of values (i.e., 1, 2, 3, and 4). Table 14 shows that Item 29 (Maintains line of travel to locate curb/ ramp / truncated domes) had the highest mean at 3.26 (*SD* = 1.14). Item 35 (Crosses at appropriate time) had the lowest mean at 2.37 (*SD* = 1.20).

Table 14
Descriptive Statistics for Lighted Crossings Items

Item	*M*	*SE*	*SD*
29. Maintains line of travel to locate curb/ ramp / truncated domes	3.26	.17	1.14
30. Locates down curb using the cane	2.95	.17	1.11
31. Locates pedestrian button	2.74	.22	1.42
32. Push pedestrian button at appropriate timing	2.64	.23	1.48
33. Appropriate position at the curb	2.81	.20	1.27
34. Appropriate stance at the curb	2.77	.19	1.27
35. Crosses at appropriate time	2.37	.18	1.20
36. Sweep with cane to signal start of crossing	2.88	.18	1.18
37. Maintain line of travel while crossing	2.70	.17	1.12
38. Locates opposite curb, clears, and steps onto curb	3.07	.16	1.06
39. Locates sidewalk and resumes travel	3.21	.16	1.01

Note. $n = 43$.

Qualitative comments on the rubric revealed that several participants needed assistance to complete this task. Examples of areas where assistance was needed included locating the corner

and crossing the street at the appropriate time. A few participants appeared to use their vision to accomplish tasks such as locating the pedestrian button and determining the appropriate time to cross.

Driveways. The 4-item Driveways section of the rubric was completed by 44 participants. All items included the full range of values (i.e., 1, 2, 3, and 4). Item 43 (Maintains line of travel while crossing) had the highest mean at 3.25 (*SD* = 1.18). Item 41 (Sweep with cane to signal start of crossing) had the lowest mean at 2.50 (*SD* = 1.15). See Table 15 for items, means, standard errors, and standard deviations.

Qualitative comments indicated that some participants did not stop when approaching the driveway or alley, suggesting that participants may not have recognized the driveway or alley. A slight change in the audio instructions provided to participants could provide the needed clarification for this task. One rater stated that a participant became "turned around" in the driveway and needed redirection to get back on track.

Table 15
Descriptive Statistics for Driveway Items

Item	*M*	*SE*	*SD*
40. Detect driveway with cane and stop and listen for traffic	2.68	.20	1.31
41. Sweep with cane to signal start of crossing	2.50	.17	1.15
42. Cross at appropriate time	3.16	.16	1.03
43. Maintains line of travel while crossing	3.25	.18	1.18

Note. $n = 44$.

Obstacles. The 4-item Obstacles section of the rubric was completed by 46 participants. All items included the full range of values (i.e., 1, 2, 3, and 4). Item 44 (Straight line of travel) had the highest mean at 3.52 (*SD* = .72), and Item 45 (Detects and identifies obstacle) had the lowest mean at 2.83 (*SD* = .85). Items, means, standard errors, and standard deviations are summarized in Table 16. Written comments were not included on this section.

Table 16
Descriptive Statistics for Obstacles Items

Item	*M*	*SE*	*SD*
44. Straight line of travel	3.52	.11	.72
45. Detects and identifies obstacle	2.83	.13	.85
46. Moves around obstacle	3.00	.14	.97
47. Maintains line of travel	3.39	.13	.88

Note. $n = 46$.

Car Detection. The 5-item Car Detection section of the rubric was completed by 30 participants. Most items had the full range of values. Item 50 (Upper body protective technique) was the exception, as 97% of participants scored a "1" on this item and the remaining 3% scored a "2". As shown in Table 17, Item 51 (Finds correct location on opposite side [of car]) had the highest mean at 3.62 ($SD = .86$). Item 50 (Upper body protective technique) had the lowest mean at 1.03 ($SD = .18$).

Table 17
Descriptive Statistics for Car Detection Items

Item	*M*	*SE*	*SD*
48. Detects and identifies car in line of travel	2.60	.19	1.04
49. Trails with cane around car	2.87	.21	1.17
50. Upper body protective technique	1.03	.03	.18
51. Finds correct location on opposite side	3.62	.16	.86
52. Turns and resumes line of travel	3.17	.19	1.04

Note. $n = 30$.

The written comments on this section of the rubric coincided with the low scores for upper body protective technique, as one rater noted that many participants did not properly demonstrate this skill. Furthermore, some participants may have traveled around the car without contacting it with their canes. These participants may have negotiated the car using their vision or hearing, or by feeling the heat from the sun reflecting off the car. Other notes indicated that direction of travel around the car was not specifically included in the rubric, and that several participants went the wrong way around the car.

Stairs. The 12-item Stairs section of the rubric was completed by 44 participants. Eleven of the twelve items included the full range of values. For Item 62 (Interchanging of feet while ascending), 4.5% of participants scored a "1" and 95.5% scored a "4". Consequently, Item 62 had the highest mean at 3.86 (*SD* = .63). Item 64 (Clearing at the top) had the lowest mean at 2.73 (*SD* = 1.13). Refer to Table 18 for the items, means, standard errors, and standard deviations. Raters did not include any qualitative notes on this section of the rubric.

Table 18
Descriptive Statistics for Stairs Items

Item	*M*	*SE*	*SD*
53. Approach using full coverage cane technique and locates the edge of the first step with the cane	3.53	.14	.91
54. Locate the handrail	2.86	.19	1.29
55. Proper cane position when descending	3.45	.12	.82
56. Interchanging of feet while descending	3.43	.17	1.13
57. Locating the landing	3.48	.12	.82
58. Clearing at the bottom	2.98	.16	1.06
59. Approach using full coverage cane technique and locates the edge of the first step with the cane	3.25	.15	.97
60. Locate the handrail	3.30	.16	1.09
61. Proper cane position when ascending	3.47	.14	.88
62. Interchanging of feet while ascending	3.86	.10	.63
63. Locating the landing	3.20	.13	.88
64. Clearing at the top	2.73	.17	1.13

Note. $n = 44$.

Escalators. The 8-item Escalators section of the rubric was completed by 38 participants. Seven of these items included the full range of values. No participants received a score of "2" for Item 65 (Locate the escalator). Item 65 also had the highest mean at 3.54 (*SD* = .77). Item 70 (Proper foot placement) had the lowest mean at 1.76 (*SD* = .97). Additional information is provided in Table 19.

Table 19
Descriptive Statistics for Escalators Items

Item	*M*	*SE*	*SD*
65. Locate the escalator	3.54	.13	.77
66. Approach the escalator safely	3.00	.17	1.07
67. Determine the direction of movement	3.18	.17	1.04
68. Approach edge of platform	3.32	.16	.94
69. Board the escalator safely	3.26	.16	.98
70. Proper foot placement	1.76	.16	.97
71. Exit the escalator safely	3.13	.16	.96
72. Clear landing and step away	2.05	.12	.73

Note. $n = 38$.

The qualitative comments provided some clarification regarding the low mean for Item 70. The comments indicated that several participants relied on cues from the cane instead of their feet to get information about the escalators. Based on the nature of the comments, this rater seemed to feel strongly that foot position on escalators does not matter if cane position is correct. Additionally, one participant attempted to use the escalator for the first time and had to be stopped by the O&M specialist due to safety concerns.

Doors. The 6-item Doors section of the rubric was completed by 42 participants. No participants received a score of "1" for Item 76 (Traverses through doorway). Item 75 (Free hand opens door) had the highest mean at 3.38 (*SD* = .80), and Item 74 (Utilizes cane to find doorknob) had the lowest mean at 1.64 (*SD* = .93). Items, means, standard errors, and standard deviations are provided in Table 20. The written comments indicated that at least one of the doors was self-closing, which may explain the low mean for Item 77 (Closes door).

Table 20
Descriptive Statistics for Doors Items

Item	*M*	*SE*	*SD*
73. Contacts the door with cane	2.95	.18	1.17
74. Utilizes cane to find doorknob	1.64	.14	.93
75. Free hand opens door	3.38	.12	.80
76. Traverses through doorway	2.88	.11	.71
77. Closes door	1.86	.17	1.12
78. Employs proper cane technique to clear area	2.31	.15	1.00

Note. $n = 42$.

Seeking Assistance. The 6-item Seeking Assistance section of the rubric was completed by 29 participants. All items included the full range of values (i.e., 1, 2, 3, and 4). Item 80 (Brings cane to appropriate position) had the highest mean at 3.48 (*SD* = .87). Item 81 (Detects a person) had the lowest mean at 2.89 (*SD* = 1.32). Refer to Table 21 for additional items, means, standard errors, and standard deviations. Qualitative comments indicated that some participants requested human guide assistance to locate the destination.

Table 21
Descriptive Statistics for Seeking Assistance Items

Item	*M*	*SE*	*SD*
79. Stops	3.03	.23	1.24
80. Brings cane to appropriate position	3.48	.16	.87
81. Detects a person	2.89	.25	1.32
82. Asks for assistance	3.34	.21	1.11
83. Asks appropriate questions	3.14	.15	.79
84. Uses info and heads in correct direction	3.11	.20	1.03

Note. $n = 29$.

Bus Travel. The 10-item Bus Travel section of the rubric was completed by 16 participants. Eight of these items did not include the full range of values; however, these items are not discussed in detail due to the small sample size for this section. As shown in Table 22, Item 92 (Proper bus etiquette) had the highest mean at 3.85 (*SD* = .38). Item 89 (Pay or show ID to bus driver) had the lowest mean at 1.21 (*SD* = .80).

Table 22
Descriptive Statistics for Bus Travel Items

Item	*M*	*SE*	*SD*
85. Locates bus stop	2.25	.32	1.29
86. Waits for bus appropriately	3.43	.23	.85
87. Solicit driver for bus information	3.00	.32	1.25
88. Board bus	3.46	.22	.78
89. Pay or show ID to bus driver	1.21	.21	.80
90. Solicit assistance to find seat	2.27	.37	1.44
91. Locate seat	3.13	.09	.35
92. Proper bus etiquette	3.85	.10	.38
93. Solicit assistance for destination	2.07	.40	1.49
94. Exit bus	3.14	.10	.36

Note. $n = 16$.

The qualitative notes indicated that some participants used human guide to locate the bus stop, and others did not need to wait for the bus as their arrival at the bus stop coincided with the arrival of the bus. After boarding the bus, one participant appeared to visually locate an open seat, rather than soliciting assistance. Another aspect of the bus travel task was a volunteer who acted as a "stranger" on the bus. The bus stranger was scripted to talk to participants to provide a realistic distraction from the task. This aspect of bus travel was not reflected in the quantitative rubric scores, but the raters made numerous notes on the rubric describing participants' reactions to the stranger. Responses to the stranger ranged from completely ignoring the stranger to divulging all kinds of personal information, such as his or her last name.

Human Guide. The 7-item Human Guide section of the rubric was completed by 43 participants. No participants received a score of "1" for Item 96 (Stance). Item 96 also had the highest mean at 3.79 ($SD = .80$). Item 100 (Demonstrates an about face) had the lowest mean at 1.79 ($SD = 1.26$). See Table 23 for items, means, standard errors, and standard deviations.

Table 23
Descriptive Statistics for Human Guide Items

Item	*M*	*SE*	*SD*
95. Grasp (elbow or hand grip)	3.56	.12	.80
96. Stance (half a step behind)	3.79	.09	.56
97. Narrow passage stance	3.00	.14	.90
98. Demonstrates changing sides	3.07	.16	1.03
99. Demonstrates Hines Break for refusing aide	2.19	.16	1.08
100. Demonstrates an about face (turning around)	1.79	.19	1.26
101. Demonstrates going through a closed door	2.67	.14	.94

Note. $n = 43$.

The qualitative comments on the rubric provided further insight into specific areas of difficulty for participants. For instance, several participants received lower scores due to: (a) using a light or improper grasp, (b) losing contact with the guide while changing sides, and (c) not extending their arm while going through a narrow passage. Comments also indicated that at least eight participants did not demonstrate an about face with the guide due to lack of familiarity with the skill.

Care of the Cane. The 5-item Care of the Cane section of the rubric was completed by 29 participants. No participants received a score of "1" on Item 103 (Unfolding the cane) and Item 104 (Folding the cane). Item 104 had the highest mean at 3.75 ($SD = .52$). Item 106 (Why red tip) had the lowest mean at 2.21 ($SD = 1.01$). Items, means, standard errors, and standard deviations are displayed in Table 24. A written note on the rubric for Item 105 (Color of the cane) indicated that one participant's cane was black and blue. This comment may reflect a need to broaden the wording of this item, as canes are available in colors other than the traditional white and red.

Table 24
Descriptive Statistics for Care of the Cane Items

Item	*M*	*SE*	*SD*
102. Parts of the cane	3.34	.19	1.01
103. Unfolding the cane	3.50	.13	.69
104. Folding the cane	3.75	.10	.52
105. Color of the cane	2.97	.18	.98
106. Why red tip	2.21	.19	1.01

Note. $n = 29$.

Orientation Questions. The 8-item Orientation Questions section of the rubric was completed by 47 participants. Two items did not include the full range of values; no 2's were assigned for Item 108 (Identify perpendicular traffic) and no 3's were assigned for Item 109 (Where is near parallel traffic). As shown in Table 25, Item 108 had the highest mean at 3.70 (*SD* = .86). Item 114 (Identify left turning traffic) had the lowest mean at 2.68 (*SD* = 1.35). The written notes on this section of the rubric revealed that at least one participant wore hearing aids. This participant had difficulty identifying the surge of parallel traffic.

Table 25
Descriptive Statistics for Orientation Questions Items

Item	*M*	*SE*	*SD*
107. Identify parallel traffic	3.53	.15	1.04
108. Identify perpendicular traffic	3.70	.13	.86
109. Where is near parallel traffic	3.34	.18	1.22
110. Where is far parallel traffic	3.15	.20	1.32
111. Identify surge of parallel traffic	2.79	.20	1.37
112. Identify surge of perpendicular traffic	2.85	.21	1.40
113. Identify right turning traffic	3.26	.16	1.11
114. Identify left turning traffic	2.68	.20	1.35

Note. $n = 47$.

Cardinal Directions. The 8-item Cardinal Directions section of the rubric was completed by 46 participants. No participants received a score of "2" for Item 115 (Turns to North) and Item 120 (How many degrees between North and South). Items 115 and 116 (Turns to South) both had the highest mean at 3.70. Items 119 (How many degrees between North and West) and

121 (Point to Southwest) had the lowest mean at 2.72. See Table 26 for items, means, standard errors, and standard deviations. A qualitative comment for Item 119 revealed an example that was not specified in the rubric. When asked how many degrees between North and West, this participant answered 270.

Table 26
Descriptive Statistics for Cardinal Directions Items

Item	*M*	*SE*	*SD*
115. Turns to North	3.70	.10	.70
116. Turns to South	3.70	.10	.66
117. Turns to East	3.30	.17	1.15
118. Turns to West	3.33	.17	1.16
119. How many degrees between North and West	2.72	.20	1.34
120. How many degrees between North and South	2.91	.19	1.28
121. Point to Southwest	2.72	.19	1.29
122. Point to Northeast	3.02	.18	1.22

Note. $n = 46$.

Summary

Across sections, item means ranged from 1.03 ($SD = .18$) to 3.86 ($SD = .63$). Participants had the highest scores for the following items: (a) interchanging of feet while ascending [stairs] ($M = 3.86$, $SD = .63$) (b) proper bus etiquette ($M = 3.85$, $SD = .38$), (c) [human guide] stance ($M = 3.79$, $SD = .56$), and (d) folding the cane ($M = 3.75$, $SD = .52$). Participants scored lowest on the following items: (a) upper body protective technique ($M = 1.03$, $SD = .18$), (b) pay or show ID to bus driver ($M = 1.21$, $SD = .80$), (c) utilizes cane to find doorknob ($M = 1.64$, $SD = .93$), and (d) proper foot placement on escalator ($M = 1.76$, $SD = .97$).

Aim 2

Internal Consistency of the Rubric's Sub-scales

The internal consistency analysis was completed for items scored for both age groups at all three sites. Three additional items (10, 62, and 77) were excluded from further analysis due to

poor psychometric properties or validity concerns, as identified in the prior section. The remaining 85 items were grouped conceptually by section of the rubric. The minimum target value of alpha was .70, and initial alpha coefficients for the sub-scales ranged from .62 to .89.

The initial alpha for the nine items in the Cane Technique 1 sub-scale was .79. Although the alpha coefficient was above the minimum value, an inspection of the item-total statistics revealed that Item 6 (Arc height) had a corrected item-total correlation of .18. Item 6 was deleted and the alpha coefficient for the remaining eight items increased to .81, which is indicative of good internal consistency. The original nine items in the Cane Technique 2 sub-scale had an alpha of .86. Item 12 (Hand position) was deleted due to its corrected item-total correlation of .17. The sub-scale was re-analyzed, and the final eight items had good internal consistency (a = .87).

The 9-item Residential Street Crossing and 11-item Lighted Street Crossing sub-scales had alpha coefficients of .77 and .89, respectively. Corrected item-total correlations were greater than .30 for all items in these sub-scales; thus, all of the original items were retained. The four items in the Business Driveways section of the rubric had an initial alpha coefficient of .64. Item 43 (Maintain line of travel while crossing [driveway]) was removed due to its low corrected item-total correlation of .11. The sub-scale was re-analyzed and the final three items had acceptable internal consistency (a = .77). The items in the Negotiating Obstacles section also had acceptable internal consistency (a = .76), and all four items were retained for the final sub-scale.

The original 11 items in the Stairs section of the rubric had an alpha coefficient of .85. Item 56 (Interchanging of feet while descending) had a corrected item-total correlation of .19. This item was deleted from the sub-scale and the remaining 10 items had good internal consistency (a = .85). The initial six items in the Doors sub-scale had the lowest alpha coefficient at .62.

The item-total statistics indicated that Item 75 (Free hand opens door) had a corrected item-total correlation of .14. This item was deleted from the sub-scale, and although the final five items had questionable internal consistency (a = .65), the mean inter-item correlation of .33 was adequate.

The 7-item Human Guide sub-scale had questionable internal consistency (a = .63). Item 100 (Demonstrates an about face) had a corrected item-total correlation of .24 and deleting this item would have increased the alpha to .65. Subsequent analyses indicated that removal of Item 100 led to a decrease in the item-total correlations for several other items. Conceptually speaking, deleting too many items would have created a sub-scale that was too narrow, so the seven items were all included in the final sub-scale. The eight items in the Orientation Questions section had good internal consistency (a = .80) and all items were included in the final sub-scale. Finally, the alpha coefficient for the original eight items in the Cardinal Directions section was .76. Item 119 (How many degrees between North and West) had a corrected item-total correlation of .28. After deleting this item, the final 7-item sub-scale had acceptable internal consistency (a = .77).

The final 11 sub-scales included 79 items, as six items were deleted due to low item-total correlations. Overall, five sub-scales had good internal consistency (.80 or higher), four sub-scales had acceptable internal consistency (.70 or higher), and two sub-scales (Doors and Human Guide) had questionable internal consistency (below .70). Table 27 shows that several of the minimum values for the individual inter-item correlations were low; however, the mean inter-item correlations were within an acceptable range of .23 and .54.

Table 27
Summary of Internal Consistency Results for Sub-scales of the Cane Quest Rubric

			Inter-item correlations			Item-total correlations	
Sub-scale	Items	*a*	*M*	Min.	Max.	Min.	Max.
Cane Technique 1	8	.81	.35	-.05	.75	.37	.68
Cane Technique 2	8	.87	.45	.20	.72	.51	.78
Residential Crossings	9	.77	.27	-.05	.73	.37	.52
Lighted Crossings	11	.89	.43	.15	.88	.52	.73
Business Driveways	3	.77	.54	.50	.60	.56	.64
Negotiating Obstacles	4	.76	.45	.15	.68	.49	.66
Stairs	10	.86	.38	-.08	.64	.40	.72
Doors	4	.65	.33	.12	.50	.32	.60
Human Guide	7	.63	.23	-.04	.48	.24	.54
Orientation Questions	8	.80	.34	.12	.74	.37	.63
Cardinal Directions	7	.77	.35	.11	.96	.32	.67

Composite Scores

The 79 individual items were grouped into 11 sub-scales corresponding to the internal consistency analysis, with each sub-scale representing one section of the rubric. Composite scores were created based on the item means and descriptive statistics are provided in Table 28. The values for skewness and kurtosis suggested that the values approximated a normal distribution; however, all variables were slightly negatively skewed.

Mean values for the composite variables ranged from 2.45 to 3.24. The sub-scales with the highest means were (a) cardinal directions, (b) stairs, and (c) negotiating obstacles. The sub-scales with the lowest means were (a) doors, (b) driveways, and (c) lighted crossings. Table 28 shows the means, standard errors, confidence intervals, and standard deviations for the composite variables.

Table 28
Descriptive Statistics for 11 Composite Variables from the Cane Quest Rubric

Sub-scale	*n*	*M*	*SE*	95% CI	*SD*
Cane Technique 1	45	3.04	.09	[2.86, 3.23]	.61
Cane Technique 2	43	3.04	.11	[2.82, 3.26]	.72
Residential Crossings	45	3.15	.09	[2.97, 3.34]	.62
Lighted Crossings	43	2.85	.13	[2.60, 3.11]	.82
Driveways	44	2.78	.15	[2.49, 3.08]	.97
Negotiating Obstacles	46	3.18	.10	[2.99, 3.38]	.65
Stairs	44	3.22	.10	[3.03, 3.42]	.65
Doors	42	2.45	.10	[2.24, 2.66]	.68
Human Guide	43	2.87	.08	[2.70, 3.03]	.54
Orientation	47	3.16	.11	[2.93, 3.39]	.78
Cardinal Directions	46	3.24	.11	[3.03, 3.45]	.71

Demographic Comparisons

Composite variables were examined based on four demographic variables: (a) age group, (b) vision, (c) gender, and (d) region.

Age Group. Independent samples t-tests were conducted to compare scores for the Explorer (7^{th} to 9^{th} grade) and Trailblazer (10^{th} to 12^{th} grade) groups. Means and standard deviations for the composite variables based on age group are included in Table 29. To minimize the possibility of Type-I error, a Bonferroni correction of .05/11 was applied to these analyses and a significance level of .005 was used. The differences in scores for the composite variables were not statistically significant.

Table 29
Composite Variables by Age Group

Sub-scale	*M* (*SD*)	
	EX	TB
Cane Technique 1	3.11 (.62)	3.00 (.62)
Cane Technique 2	2.85 (.53)	3.17 (.80)
Residential Crossings	3.07 (.61)	3.21 (.62)
Lighted Crossings	2.47 (.82)	3.13 (.71)
Driveways	2.60 (.92)	2.92 (1.00)
Negotiating Obstacles	3.36 (.56)	3.06 (.70)
Stairs	2.93 (.76)	3.45 (.45)
Doors	2.46 (.73)	2.44 (.65)
Human Guide	2.78 (.61)	2.93 (.47)
Orientation	2.80 (.87)	3.41 (.61)
Cardinal Directions	3.22 (.64)	3.25 (.77)

Note. EX = Explorers; TB = Trailblazers.

Vision. Independent samples t-tests were conducted to compare scores for the B1 (blind) and B2 (low vision) groups. Table 30 provides means and standard deviations for the composite variables based on vision. Using the Bonferroni-corrected significance level of .005, no significant differences were found for the composite variables.

Table 30
Composite Variables by Vision

Sub-scale	*M* (*SD*)	
	B1 (Blind)	B2 (Low vision)
Cane Technique 1	2.96 (.56)	3.21 (.71)
Cane Technique 2	2.91 (.76)	3.32 (.52)
Residential Crossings	3.07 (.63)	3.32 (.58)
Lighted Crossings	2.74 (.86)	3.07 (.72)
Driveways	2.81 (.99)	2.71 (.96)
Negotiating Obstacles	3.10 (.63)	3.35 (.71)
Stairs	3.18 (.67)	3.33 (.61)
Doors	2.56 (.61)	2.21 (.76)
Human Guide	2.92 (.52)	2.76 (.58)
Orientation	3.00 (.80)	3.50 (.63)
Cardinal Directions	3.17 (.72)	3.38 (.71)

Gender. Independent samples t-tests were conducted to compare scores for the male and female participants. The means and standard deviations for the composite variables by gender are shown in Table 31. To adjust for multiple comparisons, a Bonferroni-corrected significance level of .005 was used and no significant differences by gender were found for any of the composite variables.

Table 31
Composite Variables by Gender

Sub-scale	*M* (*SD*)	
	Male	Female
Cane Technique 1	3.11 (.58)	2.98 (.65)
Cane Technique 2	2.96 (.84)	3.10 (.63)
Residential Crossings	3.19 (.69)	3.12 (.56)
Lighted Crossings	2.85 (.76)	2.86 (.89)
Driveways	2.82 (.86)	2.75 (1.06)
Negotiating Obstacles	3.15 (.71)	3.21 (.62)
Stairs	3.04 (.66)	3.36 (.62)
Doors	2.44 (.64)	2.45 (.71)
Human Guide	2.81 (.63)	2.91 (.47)
Orientation	3.24 (.82)	3.10 (.76)
Cardinal Directions	3.17 (.87)	3.30 (.56)

Region. A one-way ANOVA was conducted to examine differences in scores on the composite variables for the three regions. Table 32 provides means and standard deviations for the composite variables for each region. A Bonferroni correction was applied to these analyses and a significance level of .05/11, or .005, was used. The results for obstacles were significant, $F(2,43) = 10.32$, $p < .001$. Tukey's HSD test indicated that participants in OK had significantly higher scores than participants in both FL ($p < .001$) and CA ($p = .001$); however, scores between FL and CA did not differ significantly ($p = .26$).

Table 32
Composite Variables by Region

Sub-scale	*M* (*SD*)		
	CA	FL	OK
Cane Technique 1	3.02 (.57)	3.31 (.46)	2.86 (.87)
Cane Technique 2	2.99 (.67)	3.59 (.51)	2.75 (.84)
Residential Crossings	3.28 (.59)	2.82 (.41)	3.01 (.78)
Lighted Crossings	2.99 (.66)	2.83 (.83)	2.41 (1.20)
Driveways	2.90 (1.00)	2.79 (.64)	2.33 (1.11)
Negotiating Obstacles[a]	3.10 (.58)	2.75 (.67)	3.94 (.12)
Stairs	3.19 (.69)	3.54 (.39)	3.04 (.69)
Doors	2.25 (.65)	2.81 (.51)	2.72 (.73)
Human Guide	2.92 (.53)	2.84 (.58)	2.73 (.55)
Orientation	3.18 (.78)	3.34 (.53)	2.92 (.99)
Cardinal Directions	3.21 (.68)	3.63 (.42)	2.96 (.97)

[a]Scores for OK were significantly higher than scores for CA and FL.

Summary. No significant differences by region, age group, vision, or gender were found for the majority of the composite variables. The exception was for the Obstacles sub-scale, as participants in Oklahoma scored significantly higher on Obstacles than participants in the other two regions. Based on this finding, the Obstacles sub-scale was not included in subsequent analyses.

Relationships Between Composite Variables

Pearson correlations were conducted to examine relationships between sub-scales, and many positive correlations were found. A large positive correlation was found between the two cane technique sub-scales ($r = .65$, $p < .001$). A medium positive correlation was found between the two street crossing sub-scales ($r = .46$, $p = .007$). See Table 33 for the full correlation matrix.

Table 33
Pearson Correlation Matrix of Rubric Composite Variables

Sub-scale	1	2	3	4	5	6	7	8	9	10
1. Cane Technique 1	--									
2. Cane Technique 2	.65**	--								
3. Residential Crossings	.25	.33	--							
4. Lighted Crossings	.41*	.60**	.46**	--						
5. Driveways	.12	.13	.14	.32	--					
6. Stairs	.42*	.55**	.12	.55**	.28	--				
7. Doors	.14	-.07	-.41*	-.12	.14	.17	--			
8. Human Guide	.24	.09	.03	.31	.18	.42*	.41*	--		
9. Orientation	.25	.45**	.38*	.51**	.42*	.32	.08	.26	--	
10. Cardinal Directions	.57**	.52**	.37*	.57**	.32	.41*	.07	.22	.37*	--

Note. $n = 33$.
*$p < .05$. **$p < .01$.

Aim 3

O&M Specialists' Agreement with Expert Ratings

Although 38 raters turned in forms with their training scores, only 29 forms were complete. Only those raters with full data were included in the following analyses of 13 video examples. Overall percent agreement with expert ratings was 74%. As shown in Table 34, percent agreement for individual items ranged from 24% to 100%.

Table 34
Percent Agreement with Expert Ratings

Sub-scale	Item	Score	Agreements	%
Stairs	53 (Ex. 1)	3	16	55
Stairs	53 (Ex. 2)	4	26	90
Stairs	57	4	23	79
Stairs	58	2	28	97
Escalators	67	4	21	72
Escalators	68	4	26	90
Residential Crossings	22 (Ex. 1)	4	24	83
Residential Crossings	22 (Ex. 2)	3	9	31
Residential Crossings	23	4	29	100
Lighted Crossings	29	4	29	100
Lighted Crossings	35	2	7	24
Cane Technique 1	8 (Ex. 1)	4	29	100
Cane Technique 1	8 (Ex. 2)	2	12	41

Note. $n = 29$.

Inter-rater Reliability of Video Ratings

ICC (2,1) was used to estimate inter-rater reliability for the rubric scores based on the 13 video examples. The ICC value was computed at the item level for 29 raters using a two-way random effects absolute model. Table 35 shows that the single-measures ICC was .85, 95% CI [.74, .94], which indicates an excellent level of agreement (Cicchetti, 1994). The ICC value suggests that 85% of the variance in scores reflects true score variance and the remaining 15% of the variance is due to error.

Inter-rater Reliability of Ratings in Real-time

ICC(1,1) was used to estimate inter-rater reliability for the rubric scores based on the scores from pairs of raters scored in real-time during Cane Quest. Twelve different sub-scales were included in the analysis, and eight of the sub-scales were scored twice. ICCs were computed at the item and sub-scale levels using a one-way model (see Table 35). At the item level, the ICC was .71, 95% CI [.62, .78], which is considered a good level of agreement (Cicchetti, 1994). This value indicates that 71% of the variance in items is true score variance and the remaining 29% of the variance reflects error. At the sub-scale level, the ICC was .75, [95% CI .48, .89], which is an excellent level of agreement according to Cicchetti (1994). This ICC value indicates that 75% of the variance in sub-scale scores can be attributed to the true scores, and 25% of the variance is due to error.

Table 35
Intraclass Correlation Coefficients for Video Examples and Real-time Ratings

Data Source	ICC	95% CI	*F*	df	*p*
Video Examples	.85[a]	[.74, .94]	165.24	12, 336	.000
Live Ratings					
Item-level	.71[b]	[.62, .78]	5.93	150	.000
Sub-scale-level	.75[b]	[.48, .89]	7.04	19	.000

[a]ICC(2,1)
[b]ICC(1,1)

Aim 4

Descriptive Analysis of Skills Checklist Data

Skills checklist data were available for 45 participants. The 17 selected skills checklist variables were examined for missing values and only 33% of participants (n = 15) had full data for all items. The following four variables had more than 20% missing data and were excluded from further analysis: (a) cross at accessible signals, (b) cross major signal intersections with left turn signals, (c) identify street layouts, and (d) traffic patterns. Two additional items (move around obstacles in residential area and move around obstacles in business area) were excluded since the corresponding rubric sub-scale (Obstacles) was dropped.

Descriptive statistics were examined for the remaining 11 items (see Table 36). All variables were slightly negatively skewed; however, values for skewness and kurtosis were within an acceptable range. Means ranged from 2.95 to 3.44. The three items with the highest means were constant contact technique (M = 3.44, SD = .66); human guide (M = 3.39, SD = .69); and locate, approach, ascend, and descend stairs (M = 3.39, SD = .74). The three items with the lowest means were two-point touch technique (M = 2.95, SD = .91), cross at signal intersections parallel to a major street (M = 3.03, SD = .92), and cross in a counter-clockwise direction (M = 3.23, SD = .83).

Table 36
Descriptive Statistics for Skills Checklist Items

Scale	Item	*n*	*M*	*SD*
Basic	Human guide	44	3.39	.69
	Cardinal directions	41	3.27	.63
	Two-point touch technique	42	2.95	.91
	Touch and drag technique	40	3.23	.73
	Constant contact technique	44	3.44	.66
	Locate, approach, ascend, and descend stairs	41	3.39	.74
Advanced	Cross residential streets	43	3.37	.73
	Cross in a clockwise direction	39	3.28	.83
	Cross in a counter-clockwise direction	40	3.23	.83
	Reposition self on sidewalk and walk in desired direction	41	3.32	.69
	Cross at signal intersections parallel to a major street	38	3.03	.92

Internal Consistency of Skills Checklist Composite Variables

The items from the skills checklist were grouped into two scales in alignment with the rubric. The Basic Skills scale included six items (a = .85) and the Advanced Skills scale included five items (a = .94). Table 37 provides means, standard errors, confidence intervals, and standard deviations for the skills checklist composite variables, and Table 38 provides information about the corresponding rubric scales.

Table 37
Descriptive Statistics for Composite Variables from the Skills Checklist

Scale	*n*	*M*	*SE*	95% CI	*SD*	*a*
Basic	43	3.28	.08	[3.11, 3.45]	.55	.85
Advanced	39	3.26	.12	[3.03, 3.50]	.72	.94

Table 38
Descriptive Statistics for Two Broad Scales of the Rubric

Scale	Sub-scale	*n*	*M*	*SE*	95% CI	*SD*	*a*
Basic	Cane Technique 1 Cane Technique 2 Stairs Human Guide Cardinal Directions	44	3.10	.07	[2.96, 3.24]	.46	.80
Advanced	Residential Crossings Lighted Crossings Orientation Questions	46	3.06	.09	[2.88, 3.23]	.59	.71

Note. Driveways and Doors sub-scales were excluded due to lack of alignment with items from the Skills Checklist for Cane Quest.

Exploratory Multitrait-Multimethod Matrix

Table 39 shows the exploratory MTMM matrix for the four variables. The internal consistency estimates for each measure are provided in parentheses in the reliability diagonal. These monotrait-monomethod values ranged from .71 to .94, and they are the highest values in the matrix.

Table 39
Multitrait-Multimethod Matrix (*n* = 35)

	Traits	Rubric		Skills Checklist	
		Basic	Advanced	Basic	Advanced
Rubric	Basic	(.80)			
	Advanced	.49**	(.71)		
Skills Checklist	Basic	*.35**	.36*	(.85)	
	Advanced	.42*	*.57***	.46**	(.94)

Note. The reliability diagonal values are in parenthesis and the validity diagonal values are italicized.
*$p < .05$. **$p < .01$.

Convergent validity was evaluated through examination of the values in the (italicized) validity diagonal. These convergent validity coefficients portray associations among the

monotrait-heteromethod values, or measures of the same trait by different methods. Campbell & Fiske (1959) indicated that these values should be large and significantly different from zero. The convergent validity coefficient for Basic Skills was medium in magnitude ($r = .35$, $p = .04$) and the coefficient for Advanced Skills was large in magnitude ($r = .57$, $p < .001$). Although both coefficients were significantly different from zero, the coefficient for Basic Skills was lower than desired.

Discriminant validity was evaluated using guidelines outlined by Campbell and Fiske (1959). First, the convergent validity coefficient values should be higher than the other values in the same column and row. Table 39 shows that the convergent validity coefficient for Basic Skills was not the highest in its column or row. The convergent validity coefficient for Advanced Skills was the highest in its row and column. Second, the convergent validity coefficients should be higher than the heterotrait-monomethod coefficients, which measure different traits by the same method. The convergent validity coefficient of .35 for Basic Skills was not higher than the heterotrait-monomethod coefficients of .49 for the rubric and .46 for the skills checklist. On the other hand, the convergent validity coefficient of .57 for Advanced Skills was higher than both heterotrait-monomethod coefficients. These findings provide evidence of discriminant validity for Advanced Skills, but not for Basic Skills.

Aim 5

The O&M Evaluation Form was completed by 23 of the 43 O&M specialists for a response rate of 54%. The five open-ended questions had varying responses rates, ranging from 26% to 65%. Table 40 provides an overview of the numbers and percentages of responses for each question.

Table 40
Numbers and Percentages of Responses to Open-Ended Questions

Question	*n*	%
1. What aspects of training could be improved?	14	61
2. What aspects of the route could be improved?	15	65
3. Is there a specific checkpoint that is too challenging for contestants?	10	44
4. How could BIA best support the recruitment efforts of O&Ms?	8	35
5. How can we make Cane Quest more appealing for students and O&Ms?	6	26

O&M Specialists' Perceptions of the Training Session

Quantitative. For the training section, most responses fell into the categories of Strongly Agree/Excellent and Agree/Good. No responses were Disagree/Poor or Strongly Disagree/Very Poor. Most (87%) respondents either strongly agreed or agreed that the training session prepared them to properly score and do their jobs. Similarly, 83% of respondents indicated that they strongly agreed or agreed that the job assignment was clear and easy to understand, and 87% strongly agreed or agreed that the training video was helpful and easy to follow. Most respondents (83%) gave the training video a rating of excellent or good.

Qualitative. Despite the overall positive ratings, several respondents provided suggestions for improving the training video. One respondent requested that more video examples be incorporated into the session. Two respondents suggested that the video examples provide more practice scoring 2's and 3's, which are more "tricky" to score. Other respondents suggested that the video provide clarification of the more ambiguous aspects of scoring, such as positioning at the corner for street crossings and expectations for a score of "4." One rater expressed frustration about the nature of scoring, indicating that it differed from what he or she was taught.

The training session emphasized scoring procedures and promoting consistency in scoring; however, some respondents indicated that additions to the training session could be

helpful. Specific suggestions were (a) doing a trial run, (b) providing raters with a copy of the participants' audio instructions, and (c) including training on the route layout and starting points.

Respondents also recognized that time constraints limited the amount of content that could be covered during the morning training session. Several suggestions were provided for increasing the efficiency of the training. Specific suggestions included providing the rubric to raters in advance, having raters complete portions of the training at home, and using an audience response system (e.g., clickers) to tally up responses. Implementing some of the changes would free up more time during the morning session to discuss discrepancies in scoring.

O&M Specialists' Perceptions of the Routes and Scoring Procedures

Quantitative. As shown in Table 41, most responses for the routes and scoring section were Strongly Agree, Agree, or Neutral. No respondents answered Disagree for any items, but Strongly Disagree was chosen for three items. Most respondents (74%) strongly agreed or agreed that the shotgun start approach was efficient, and 83% strongly agreed or agreed that the rubric was clear and easy to follow. Reponses regarding the difficulty of the route were slightly more mixed, as 65% of respondents selected Strongly Agree or Agree for this item.

Qualitative. Some raters indicated that scoring of some skills was too complex. During tasks such as crossing lighted intersections, raters must focus their attention on both scoring and safety. For the skills that require greater attention to safety, scoring fewer items may help to alleviate these concerns. Other suggestions for simplifying scoring included incorporating bullet points into the rubric and eliminating less important skills. Two raters nominated the Doors sub-scale for elimination and suggested that its items were neither important nor critical for safety.

Some comments indicated that more detail could be added to the rubric and that additional examples of travel situations would assist in clarifying scoring criteria. A few

additional steps could be added to certain sub-scales to enhance scoring. Minor changes to some of the route instructions for participants and wording on the rubric could provide additional clarification for participants and raters. One rater suggested that participants with additional disabilities be allowed to compete in a separate category to provide these students with a greater chance of winning.

Table 41
Summary of Quantitative Acceptability and Feasibility Results

Item	*n* (%)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The training prepared me to properly score and do my job for the day.	10 (43.5%)	10 (43.5%)	3 (13%)	0	0
The job assignment was clear and easy to understand.	12 (52%)	7 (30.5%)	4 (17.5%)	0	0
The training video was helpful and easy to follow.	11 (48%)	9 (39%)	3 (13%)	0	0
	Excellent	Good	Average	Poor	Very Poor
Overall, how would you rate the training?	12 (52%)	8 (35%)	3 (13%)	0	0
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The shotgun start approach was efficient.	14 (61%)	3 (13%)	4 (17%)	0	2 (9%)
The scoring rubric was clear and easy to follow.	5 (22%)	14 (61%)	4 (17%)	0	0
The route was challenging.	9 (39%)	6 (26%)	7 (30%)	0	1 (4%)

CHAPTER 5

Discussion

Introduction and Summary of Results

The purpose of this pragmatic concurrent mixed methods study was to investigate the validity and reliability of a performance-based O&M rubric. The rubric was used to evaluate the O&M skills of 47 adolescents with visual impairments during a national competition. Analyses were conducted using scores from three U.S. regions to investigate psychometric properties, internal consistency, inter-rater reliability, construct validity, and acceptability. The findings provided preliminary evidence of validity and reliability of the rubric for assessing the O&M skills of adolescents with visual impairments.

Interpretation of Results

Results of the descriptive analyses indicated that most of the rubric's items had acceptable psychometric properties. Mean scores were higher than the center point of the distribution for 88% of the items. Two items were flagged for removal due to validity concerns and two items were flagged for being too easy or too difficult (i.e., more than 95% of participants received a score of "4" or "1").

A rather unexpected finding was that several items that had low means were basic skills. For example, upper body protective technique had the lowest overall mean, and the qualitative comments indicated that the scores were likely an accurate reflection of participants' performance. As students reach middle school and high school, the focus of their instruction may shift to more advanced skills. Students might practice this skill less often or use other techniques to accomplish the same task. Another possible explanation is that participants typically rely on others to inform them about head-high obstacles or other hazards in the environment.

Using the cane to find the doorknob was another item with a low mean. This particular skill primarily relates to locating the doorknob in an efficient and graceful manner. A low score indicates that participants used their hands to "grope" for the door. Using such a technique is inefficient and could lead to embarrassing social situations. Scores for "in-step" were low for both cane technique sub-scales. The technique of being in-step was intended to provide optimal foot placement preview, meaning that the cane tip makes contact with the surface before the foot contacts the surface (Blasch et al., 1996). This skill may be slightly more complex than other aspects of cane technique, which could explain the low scores.

For the lighted intersection crossings, the lowest mean was found for crossing the street at the appropriate time. Determining the correct time to cross a street is a critical safety skill, as initiating a crossing at the wrong time can lead to injury or death. Crossing unfamiliar streets requires generalization of skills across environments. As noted by Wright and Wolery (2014), this finding could indicate that participants had difficulty generalizing street crossing instruction to new intersections. Furthermore, participants might not have confidence in their abilities to execute street crossing tasks, as some adolescents with visual impairments rarely cross streets without close supervision by an O&M specialist (Cmar & Kamei-Hannan, 2015).

The qualitative comments provided additional information about participants' performance that clarified and extended the quantitative ratings. Some of the comments portrayed aspects of students' performance that could be of interest to O&M specialists and families. A disconcerting example was found in the bus travel section. Several participants were more than willing to share their personal information with the "stranger" on the bus. This finding may not be indicative of participants' typical behavior, as they could have felt comfortable sharing this information only because they were participating in an agency-sponsored event.

Regardless, this finding indicates that participants could benefit from more explicit instruction on the dangers of divulging such details about one's personal life. Encouraging raters to provide qualitative comments could strengthen the utility and value of the rubric, especially for these types of situations.

Reliability

Internal consistency and inter-rater reliability were investigated in this study. Ten of the rubric's sub-scales were included in the internal consistency analysis. Results indicated that eight of the 10 sub-scales had acceptable or good levels of internal consistency. These results must be interpreted with caution, as Cronbach's alpha is sample-dependent and does not provide evidence of unidimensionality of the sub-scales (Streiner, 2003). At this stage of scale development, factor analysis would have been the preferred method to assess unidimensionality; however, this study's sample size of 47 was well below all established sample size guidelines for factor analysis (MacCallum, Widaman, Zhang, & Hong, 1999; Mundfrom, Shaw, & Ke, 2005). The inter-item correlations and item-total correlations were examined alongside the alpha coefficients to circumvent this shortcoming (Clark & Watson, 1995).

Items that were excluded from sub-scales in this study due to restricted range or low item-total correlations may fare better with other samples. As Clark and Watson (1995) indicated, items may have different distributions when tested in different samples reflecting a wider range of skill levels. These items should not be excluded permanently from the sub-scales until they are re-examined for clarity and tested with a more diverse pool of participants.

As hypothesized, significant differences by age group, vision level, and gender were not found for the composite scores. Site differences were found for one of the 10 sub-scales. Scores on the obstacles sub-scale were significantly higher in Oklahoma than in the other two regions.

The obstacles that participants encountered during the routes were not standardized across regions. Furthermore, the leniency of the raters could have differed between the three sites. Either or both of these factors could have influenced the results.

The inter-rater reliability analyses provided initial evidence of the reliability of scores assigned by more than one rater. Additionally, results provide insight into future editorial and procedural changes that could be implemented to improve reliability. Koestler's statement that "in no aspect of work for the blind is there greater unanimity as to need—or greater controversy as to method—than in mobility teaching" was evident in this study (Koestler, 2004, p. 336). Percent agreement with the expert ratings was low for a few of the video examples, and the expert raters had difficulty reaching a consensus on several of the same examples. The results suggest that the some of the expert ratings and perhaps the choice of video examples might need to be revisited.

For the real-time ratings, inter-rater reliability was calculated at both the item and sub-scale levels. The ICCs based on sub-scale scores were slightly higher than those based on individual items. Reliability of sub-scale scores is of greatest interest for this measure, as the sub-scale scores are shared with participants and used for further analysis (Hallgren, 2012). Still, item-level reliability estimates are useful at this stage of the measure development and revision process, as items with low reliability can be flagged for further examination. Low inter-rater reliability has a negative impact on power and less measurement error will reduce the possibility of type II errors (Hallgren, 2012).

Several procedural changes could be implemented to increase reliability and reduce measurement error. First, the rater training could be structured to clarify the items with low reliability. The morning training session was not intended to cover all 122 items on the rubric.

Rather, the intent of the session was to "calibrate" raters and clarify some of the more complex aspects of scoring. Increasing the length of the session and requiring raters to complete portions of the training ahead of time could improve the consistency of ratings. Second, the training session could include more video examples of lower-rated skills. In general, higher agreement was found for the "4" ratings than for ratings of 1, 2, and 3, which indicates that raters had more difficulty agreeing on lower levels of performance.

Regardless of the quality, length, and format of the training session, several factors could have influenced how closely raters adhered to the rubric. For example, personal beliefs about the correctness of techniques could have impacted scoring. Preferred techniques may vary slightly by factors such as population served, years of experience, and university program. Second, subconscious judgments about the participants might have influenced ratings. Third, rater drift could have been a factor if raters became more lenient or strict after scoring multiple participants (Kimberlin & Winterstein, 2008). Finally, safety concerns could have impacted the reliability of live ratings, especially during tasks where the primary rater was also responsible for monitoring the safety of participants. This concern might be most evident during street crossings where traffic was present. In these cases, raters could miss some of the more detailed nuances of participants' performances. The addition of an extra O&M specialist to monitor safety during these tasks could alleviate this concern (e.g., Wright et al., 2010).

This study provides some evidence that O&M specialists can agree on application of the rubric; however, agreement on applying the rubric does not necessarily equate to agreement on correctness of techniques. O&M specialists' lack of agreement regarding O&M techniques has been widely acknowledged (e.g., Dodds et al., 1986; Wall Emerson & Corn, 2006). Differences in opinion of proper techniques were noted throughout development and revision of the rubric,

and in this study's qualitative findings. Measurement of complex skills, such as those involved in independent travel, requires professional judgment, and the items on the rubric were designed to accommodate subtle variations in technique. Although high agreement is desirable, care must be taken to avoid oversimplifying the measure in the sole interest of reliability (Graham, Milanowski, & Miller, 2012).

With the exception of the rater training video, scoring was conducted in real-time as participants performed the skills. This "live" scoring protocol has both strengths and weaknesses. As noted by Williams and colleagues (2006), live scoring best reflects the actual conditions under which the rubric will be used. O&M specialists are uniquely qualified to administer assessments of this nature, as the tasks mimic situations that they encounter during everyday instruction. O&M specialists typically observe their students from a variety of angles, and scoring in real-time allows raters to choose the most appropriate angles for viewing each skill. On the other hand, video footage might not provide the correct angles to adequately capture the behaviors in question, which could impact scoring (Wright et al., 2010; Wright & Wolery, 2014; Zebehazy et al., 2005). Ramsey and colleagues (1999) overcame this limitation by using a 3-camera motion capture system to record participants' cane technique. A multi-camera system would allow for more flexibility in viewing angles, but such a set-up is best suited for indoor laboratory settings.

Video scoring does not provide the same degree of viewing flexibility, but it would allow raters to view participants' performances multiple times and it would also facilitate more detailed inter-rater reliability studies. As noted by Wright and colleagues (2010), live inter-rater reliability could suffer when two raters view the same task from slightly different angles. A video provides consistent viewing angles for all raters. Obtaining video footage of every

participant from multiple angles is costly and requires extensive resources. Wright and colleagues (2010) found that raters were more confident when scoring video performances; however, the increase in scoring accuracy was not large enough to justify the time and effort involved in producing the videos.

Validity

Results of the exploratory MTMM matrix analysis provided some evidence of construct validity. Specifically, the findings support convergent and discriminant validity of Advanced Skills, but not Basic Skills. The high monomethod correlations are indicative of a strong methods factor, which was not entirely surprising considering the substantial correlations between the rubric's sub-scales. Interpretation of the MTMM matrix should also take into consideration the reliability of each measure (Campbell & Fiske, 1959). Reliability estimates for the two measures differed, so measurement error could have affected the magnitude of the correlations.

In general, scores from the skills checklist were higher than scores on the rubric. This finding could be explained by the inherent differences between the two measures. The skills checklist provided an overview of students' travel skills based on O&M specialists' perceptions of performance, which might not provide the most accurate representations of their students' skills. Biases related to social acceptability could have influenced the checklist scores, and O&M specialists could have interpreted and applied the checklist's rating scale in different ways (Kimberlin & Winterstein, 2008). On the other hand, the rubric scores provided objective judgments of students' performance of specific skills in distinct environments at a single point in time. As a result, the rubric scores might not capture students' typical everyday performance. These differences highlight the need to use multiple measures when assessing students' skills.

As dictated by federal policy (IDEA, 2004) and echoed by a multitude of experts in the visual impairment and O&M fields, a single measure should not be the sole means of evaluating children with disabilities (e.g., Bowen & Ferrell, 2003; Tobin & Hill, 2011). Incorporating multiple measures into the assessment process provides a more complete understanding of an individual's functioning in a given domain. Accordingly, the rubric was not intended to be the sole measure of O&M skills, and its scores should be interpreted alongside scores from other measures.

This study has high ecological validity due to its use of real-world community settings to evaluate participants' skills (Garson, 2013). The practice of conducting O&M research in laboratory-type settings has been criticized, as performance in highly controlled environments may not transfer to the real world (Kitchin & Jacobson, 1997). On the other hand, conducting O&M research in community settings also introduces a multitude of factors that researchers cannot control (Shingledecker & Foulke, 1978). Several of these environmental variables, such as weather and traffic, could have introduced additional error variance into this study.

A discussion of validity should include the potential intended and unintended consequences of introducing the scoring rubric to practitioners (Linn, Baker, & Dunbar, 1991). For example, O&M specialists could focus on teaching skills included in the rubric to the detriment of other skills. In the academic world, this phenomenon is anecdotally referred to as "teaching to the test," or in this case, "teaching to the Cane Quest."

Acceptability and Feasibility

Overall, O&M specialists rated the training session, routes, and scoring procedures favorably. Quantitative findings indicated that raters understood the training materials, found the rubric to be clear and easy to follow, and felt prepared to rate participants with the rubric. The

open-ended questions asked respondents to identify areas for improvement, and three broad recommendations were evident in their responses:

1. Expand the training video to include a wider selection of video clips and provide more examples of lower-rated performances. Broaden the scope of the training session to cover other aspects of the routes.
2. Make the in-person training session more efficient by designating portions of the training to be completed at home.
3. Re-evaluate the complexity of certain sections of the rubric. Consider adding more detail to some items and omitting or simplifying other items, especially those that require raters to monitor safety throughout the scoring process.

Results suggested that the Doors sub-scale was problematic, and respondents felt that this section of the rubric was not as important as other sections. Considering the extensive resources involved in scoring assessments of this nature, all tasks should be worthwhile of the time and attention of both participants and raters (Linn et al., 1991). Accordingly, the necessity of the Doors sub-scale might be a worthy topic for future discussion.

Limitations

Several limitations should be noted when considering the implications of this study's findings. A notable limitation was the small sample size, which prohibited the use of more sophisticated analytic approaches, such as factor analysis and Item Response Theory. This study's sample was not representative of the population of adolescents with visual impairments. To promote safety, participants had exposure to most or all skills prior to participation. As a result, these data may not reflect the full range of abilities and the results may not generalize to the larger population of students with visual impairments.

Second, private organizations were responsible for data collection and agency policies prohibited collection of some demographic information about participants. As a result, limited demographic data were available for participants, as the dataset did not include information such as visual acuity, race and ethnicity, language, and diagnosis of additional disabilities. The qualitative findings suggested that additional disabilities might have impacted some participants' performance.

Missing data and lack of control over procedures are inherent limitations of research using extant data. Efforts were made to promote consistency between sites by providing site coordinators with common training materials, a procedural handbook, and direct support for route development. Despite these efforts, a direct measure of implementation fidelity was not available. The most common reason for missing data was item non-response. Possible reasons for blank scores included (a) inability to perform a skill, (b) perceived unimportance by the rater, and (c) time constraints.

Furthermore, limited data were available on inter-rater agreement and acceptability/ feasibility. To facilitate timely completion of this research, this study only included data collected between October 2014 and April 2015 using the most recent version of the rubric. Training sessions were held at each site with a goal of 80% agreement for all raters, but the individual scores from two of the three sites were not given to the researcher for analysis.

Despite efforts for consistency across sites, several notable differences existed between the three regions. Geographical disparities were an unavoidable factor. For instance, California's intersections were wider and more complex than the intersections used in the other two regions. More subtle differences could have existed in factors such as the layout of the street corners and sidewalks.

Recommendations for Future Research

Sufficient evidence of validity and reliability of the scores from a new measure cannot be obtained from a single study. Although this study's findings are preliminary in nature, they provide a foundation for continued research. Once necessary revisions to the rubric are completed, an important intermediate step would involve a more detailed item analysis with a larger, more heterogeneous sample of adolescents with visual impairments. A larger sample would permit the use of statistical techniques such as factor analysis to verify the structure and dimensions of the rubric's scales and sub-scales. Additionally, confirmatory factor analysis provides another method of evaluating MTMM matrices for evidence of convergent and discriminant validity (e.g., Briggs & Cheek, 1986). Further investigation of construct validity might involve a comparison of the rubric's scores to scores on a different measure, such as TAPS.

This study provided estimates of inter-rater reliability based on a broad sampling of skills, participants, and raters. Future inter-rater reliability studies would benefit from having multiple raters score a greater number of participants as they perform fewer skills. Implementing these changes would facilitate the use of Generalizability Theory to estimate multiple sources of measurement error (Shavelson & Webb, 1991).

Electronic scoring, in the form of a web-based or mobile application, could enhance scoring procedures and facilitate future research. An electronic rubric could be designed to reduce missing data by prompting raters to provide a score for every item before submitting their scores. Electronic scoring could reduce human error and expedite future research by automating the processes of tabulating the contest scores and populating a database with scores from multiple sites.

Other aspects of participants' performance, such as travel time, could be investigated in future studies. Factors related to time were embedded into some rubric items, but the amount of time taken to complete each task was not measured directly in the present study. Incorporating a measure of time should be considered carefully, as participants could exhibit a reduction in performance if they rush to finish a task. Future studies might also incorporate other variables that could impact performance, such as cane length, stride length, and fatigue (e.g., LaGrow et al., 1997; Rodgers & Wall Emerson, 2005).

Participants in this study received O&M services; however, details about their instruction were not available. Relationships between direct service hours, frequency of O&M instruction, duration of O&M lessons, and participants' performance on the rubric could be examined in future studies. Research of this nature could be extended to a longitudinal analysis of skill development by investigating relationships between service delivery variables and performance trajectories. The rubric's predictive validity and responsiveness to change could also be evaluated through longitudinal studies.

Conclusion

This study provides a foundation for continued development and evaluation of the Cane Quest Rubric to measure the O&M skills of adolescents with visual impairments. In the sample tested in this study, most sections of the rubric had acceptable to good levels of internal consistency. When scoring criteria are made explicit, O&M specialists can provide consistent ratings of adolescents' skills. Overall estimates of inter-rater reliability were good, and O&M specialists rated the training, rubric, and routes favorably. Evidence of construct validity was stronger for advanced O&M skills than for basic O&M skills.

As an extension of this study, efforts are underway to develop a summary report with

individualized performance feedback for distribution to Cane Quest participants, their families, and their O&M specialists. Providing this report in a user-friendly and interpretable format will strengthen the utility of the rubric, and promote its use for instructional planning and progress monitoring. With further refinement and empirical testing, the rubric could be a promising and unique addition to the assessment tools that O&M specialists can use to document students' skills.

APPENDIX A: Cane Quest Contest Rules

CONTEST RULES

EXPLORERS AND TRAILBLAZERS

CANE Quest®
A national orientation and mobility program of Braille Institute of America

Cane Quest Contest Rules Explorers & Trailblazers

AGENCY LOGO

The contest will be held on [AGENCY DATE], from [AGENCY START to END] at [HOST AGENCY] in [HOST AGENCY LOCATION]. All contestants will receive a certificate of participation and a commemorative t-shirt. The winner for each contest age group and vision acuity level will receive prizes.

OFFICIAL CONTEST RULES:

1. Cane Quest is open to legally blind students in grades 7-12 who have received appropriate instruction in the use of the white cane, and who are both cognitively and physically able to walk independently for up to an hour at a time. To be eligible, a student's visual acuity must fall within the BI through B2 classification range as defined by the United States Association of Blind Athletes.
   - -Class B1 – No light perception in either eye up to light perception, but inability to recognize the shape of a hand at any distance or in any direction.
   - -Class B2 – From ability to recognize the shape of a hand up to visual acuity of 20/600 and/or a visual field of less than 5 degrees in the best eye with the best practical eye correction.
2. Students must use a white cane for this contest, and must wear closed-toe shoes. We also recommend bringing water, sunscreen and a hat, or rain gear, depending on weather.
3. Cane Quest will be held rain or shine, but will be postponed or cancelled due to lightning.
4. Students will be divided into groups based on age and will rotate together through route(s). Each student is assigned a unique contestant number to wear while en-route for scorekeepers to refer to. At the end of the day, scores will be tallied for both Explorer groups (7-9th graders) and both groups of Trailblazers (10-12th graders). B1 and B2 contestants in the same age group will follow the same route, but will earn prizes separately based on their acuity. Students may elect to not do all routes.
5. Prizes will be awarded according to both age and visual acuity.
6. Explorers and Trailblazers will do one route that includes both residential and light business travel. The second Explorer route includes residential and mall travel. Trailblazers will do one route that includes residential and business travel, and a second route that includes residential, bus travel and mall travel.
7. Students will be monitored at all times throughout the route by certified orientation and mobility specialists and shadowed at all times by trained volunteers. Additional staff and volunteers also will be available on all routes to call for any needed assistance. Students are not required to be proficient at all skills and are encouraged to participate to build their skills. At any time during the contest, they may seek assistance if they are not confident performing a task.
8. Students may signal to request assistance at any time by turning their cane upside down. When given assistance, they earn no points for that skill. If a student feels they are unable to complete a route, they should turn their cane upside down and ask to be escorted back to [HOST AGENCY] headquarters. They may not attempt that route again.

9. If a student goes off-route, they will first be allowed to self-correct or problem solve. If a student goes more than 10 feet off course, or appears indecisive on a direction for more than one minute, an O&M or their shadow will intervene as necessary.

10. If a student needs assistance at an intersection, their shadow will seek the guidance of the O&M stationed there. The O&M will instruct the shadow to escort the student safely across. No points would be awarded for that crossing.

11. Cane Quest is not a race. Start times for each stage will be staggered five minutes apart so students may go at their own pace. If a student is unable to complete a route within 10 minutes after the maximum time allotted, they will be escorted back to [HOST AGENCY] headquarters to ensure they are able to start the next stage on time. No points will be awarded for stations missed.

12. If a contestant is being held back by a slow walker in front of them, their shadow will indicate to the other shadow that the contestant needs to pass.

13. All routes will be located in the community surrounding the [HOST AGENCY] campus. Routes may include, but not be limited to, features such as finding a commercial storefront, using stairs, navigating various types of intersections and using an elevator or escalator.

14. If appropriate, the bus travel stage will be simulated by the [HOST AGENCY]. Additional spotters will be assigned to each bus to ensure students are monitored at all times. Students will not board city buses during this contest.

15. All judging is performed by certified O&M specialists. Three or more specialists will be stationed along each route, and each will be provided with a checklist of skills to be evaluated. Specialists will rank each contestant's performance on a scale of 1-4, according to specific definitions outlined in their scorer's training session. If a student does not perform a task or misses a station, it will be marked as "NP" for "not performed" and no score is earned.

One to four points are earned in the following ways:

- –For how well a contestant independently uses proper travel techniques and procedures
- –For how well a contestant independently uses appropriate self-advocacy skills
- –For how well a student answers questions or performs tasks during the "checkpoint" stage of the route.

If a student's safety is at all endangered through no fault of their own and are assisted by their shadow or O&M specialist, points are still awarded based on skill level.

APPENDIX B: Sample Parent Permission Form

CANE Quest
A national orientation and mobility program of Braille Institute of America

2015 PARENT PERMISSION FORM
Explorers & Trailblazers

DUE DATE: [AGENCY DATE]

AGENCY LOGO

Cane Quest seeks to motivate blind and visually impaired youth to practice proper safe travel techniques and overall orientation and mobility skills. It's designed to promote a student's confidence in any surrounding and build true mobility independence.

The Contest will be held at [HOST AGENCY] on [AGENCY DATE]
All contestants will receive a certificate of participation. The winner for each contest age group and vision acuity level will be awarded prizes.

CONTEST DESCRIPTION:

1. Cane Quest, a program developed by Braille Institute, is open to visually impaired students in grades 7-12 who have received appropriate instruction in the use of the white cane, and who are both cognitively and physically able to walk independently for an hour at a time. A student should be familiar with the skills on the enclosed checklist, but does not have to have mastered all of them.
2. A student's visual acuity must fall within the B1 through B2 classification range as defined by the United States Association of Blind Athletes.
   - **Class B1** - No light perception in either eye up to light perception, but inability to recognize the shape of a hand at any distance or in any direction.
   - **Class B2** - From ability to recognize the shape of a hand up to visual acuity of 20/600 and/or a visual field of less than 5 degrees in the best eye with the best practical eye correction.
3. Students must use a white cane for this contest, and must wear closed-toe shoes.
4. Cane Quest will be held rain or shine, but will be postponed or cancelled due to lightning.
5. Students will compete in one of four groups:

Explorers	Trail Blazers
• B1; grades 7-9	• B1; grades 10-12
• B2; grades 7-9	• B2; grades 10-12

6. Students will be monitored at all times throughout the route by certified orientation and mobility specialists and assisted one-on-one by trained volunteers.
7. The route will include two basic environments: residential and light business or business.
8. All routes will be located in the community surrounding [HOST AGENCY]. Routes may include, but not be limited to, features such as finding a commercial storefront, using stairs, and navigating various types of intersections.
9. Points are earned for accurately completing each stage using proper travel techniques and procedures within the assigned time slot.
10. All judging is performed by certified O&M specialists.

Student's Last Name _____ First Name _____

Address _____ Unit/Apt. No. _____

City _____ State _____ ZIP _____

Telephone _____ E-mail _____

Name of School _____

Page 1 of 2

Explorers & Trailblazers

Name of School District _____

Student's Age _____ Student's Grade _____ Student's T-Shirt Size (circle one) Adult S M L XL XXL

Youth S M L

O&M Specialist's Name _____

A separate skills checklist must be completed by your child's Orientation & Mobility Specialist to validate skill level and visual acuity.

PHOTOGRAPH, EDITORIAL AND RECORDING RELEASE

I hereby authorize Braille Institute of America, Inc. ("BIA") and [AGENCY NAME] to photograph, videotape, or otherwise record by visual, audio, electronic or manual means, the visual likeness and/or voice or other sounds created by the above named contestant (collectively "Reproductions"). BIA and [AGENCY NAME] may use or permit to be used the Reproductions in any CD, DVD, exhibition, display, publication, solicitation or promotional or educational material or on any website including without limitation BIA's and [AGENCY NAME'S] website, Facebook, or YouTube without compensation to the contestant, the contestant's heirs, successors or assigns.

LIABILITY RELEASE

As the parent or guardian of _____ ("Minor"), I hereby give permission for the Minor to participate in Cane Quest ("Event"), sponsored by BIA and [AGENCY NAME], to be held on [EVENT DATE].

1. I know the Event is an orientation and mobility competition taking place on public streets. I believe the Minor to be qualified and physically fit to participate in the Event.
2. I fully understand that: (a) the activities of the Event, including but not limited to, walking along public thoroughfares, crossing streets, and accessing stairs, involve certain risks and dangers which may result in serious bodily injury, including permanent disability, paralysis or even death ("Risks"); (b) these Risks and dangers may be caused by the Minor's own actions or inactions, the actions or inactions of others participating in the Event or non-participant motorists, the conditions of streets and highways, the routes selected for the travel, the rules of the Event, and/or the negligence of the "Releasees" named below; (c) there may be other risks not known to me or that are not readily foreseeable at this time; (d) the social and economic losses and/or damages that could result from those Risks could be severe and could permanently alter the Minor's future.
3. I consent to the Minor's participation in the Event and hereby accept and assume all such Risks, known and unknown, and assume all responsibility for any losses, costs and/or damages following such injury, disability, paralysis or death, even if caused in whole or in part by the negligence of the Releasees named below.
4. On behalf of the Minor and me and our respective personal representatives, heirs and assigns, I hereby release, discharge and covenant not to sue BIA and/or [AGENCY NAME], its officers, directors, employees, members, Event participants and volunteers, sponsors, promoters or advertisers, owners and lessees of the premises and vehicles used to conduct the Event, orientation and mobility specialists, consultants and other persons or entities who give recommendations, directions, or instructions regarding the premises or Event, and all of the directors, officers, agents, and employees of the foregoing (all collectively referred to as "Releasees") from and for all liability, claims, demands, losses, injuries or damages arising from the Event or related travel, including, but not limited to, emotional distress, property damage and medical expenses, caused in whole or in part by the negligence of the Releasees or otherwise.

I have read this Release, and understand that by signing it, I give up substantial rights I and/or the Minor would otherwise have to sue or recover damages for losses occasioned by the Releasees' fault. I sign this release voluntarily.

_____ _____

Parent/Guardian Signature Date

_____

Print Name

SUBMIT THIS COMPLETED PERMISSION FORM TO YOUR CHILD'S O&M SPECIALIST

APPENDIX C: Sample Contest Application Form

CANE Quest
A national orientation and mobility program of Braille Institute of America

2015 CONTEST APPLICATION FORM
Explorers & Trailblazers

DUE DATE: [AGENCY DATE]

AGENCY LOGO

Cane Quest seeks to motivate blind and visually impaired youth to practice proper safe travel techniques and overall orientation and mobility skills. It's designed to promote a student's confidence in any surrounding and build true mobility independence. **This form must be completed by an Orientation & Mobility Specialist** to validate the student's skill level and visual acuity. A separate form must also be signed by a parent or legal guardian for a student to participate.

The Contest will be held at [HOST AGENCY] on [AGENCY DATE]
All contestants will receive a certificate of participation. The winner for each contest age group and vision acuity level will be awarded prizes.

CONTEST DESCRIPTION:

1. Cane Quest is a program developed by Braille Institute and open to visually impaired students in grades 7-12 who have received appropriate instruction in the use of the white cane, and who are both cognitively and physically able to walk independently for an hour at a time. A student should be familiar with the skills on the checklist, but does not have to have mastered all of them.

2. A student's visual acuity must fall within the B1 through B2 classification range as defined by the United States Association of Blind Athletes.
   - **Class B1** - No light perception in either eye up to light perception, but inability to recognize the shape of a hand at any distance or in any direction.
   - **Class B2** - From ability to recognize the shape of a hand up to visual acuity of 20/600 and/or a visual field of less than 5 degrees in the best eye with the best practical eye correction.

3. Students must use a white cane for this contest, and must wear closed-toe shoes.

4. Cane Quest will be held rain or shine, but will be postponed or cancelled due to lightning.

5. Students will compete in one of four groups:

Explorers	Trailblazers
• B1; grades 7-9	• B1; grades 10-12
• B2; grades 7-9	• B2; grades 10-12

6. Students will be monitored at all times throughout the route by certified orientation and mobility specialists and assisted one-on-one by trained volunteers.

7. The route will include two basic environments: residential and light business or business.

8. All routes will be located in the community surrounding **[HOST AGENCY]**. Routes may include, but not be limited to, features such as finding a commercial storefront, using stairs, and navigating various types of intersections.

9. Points are earned for accurately completing each stage using proper travel techniques and procedures within the assigned time slot.

10. All judging is performed by certified O&M specialists.

ORIENTATION AND MOBILITY SPECIALISTS, TO SUBMIT A STUDENT APPLICATION
Complete this skills checklist and attach a signed and completed Parents' Permission Form and submit to:
[AGENCY CONTACT INFORMATION]

Page 1 of 3

CONTESTANT'S NAME: _____

O&M Specialist's Name _____

Specialist's Address _____

Specialist's Telephone _____ Specialist's E-mail _____

Name of School _____

Name of School District _____

Student's Age _____ Student's Grade _____ Vision Classification: B1 _____ B2 _____

SKILLS CHECKLIST FOR CANE QUEST

This checklist is to be completed by a certified Orientation & Mobility Specialist. Each of the following skills should be assessed on a scale of 1-4, with 1 representing poor and 4 representing excellent, and based on average expectations for a student at grade level. Students are not required to be proficient in all skills to participate. Contestants are encouraged to seek assistance at any time during the contest if they are not confident performing any task. All skills apply to all eligible students in grades 7-12 grade, except where specified for Trailblazers only.

	Please circle one:			
Protective Techniques	1	2	3	4
Dropped Objects	1	2	3	4
Sighted Guide Techniques	1	2	3	4
Cardinal Directions	1	2	3	4
Care of the Cane	1	2	3	4
CANE TECHNIQUES				
Two Touch Technique	1	2	3	4
Trailing with the Touch Technique	1	2	3	4
Touch and Drag Technique	1	2	3	4
Shoreline/Guideline Technique	1	2	3	4
Three-point Touch Technique	1	2	3	4
Constant Contact Technique	1	2	3	4
Diagonal Technique	1	2	3	4
RESIDENTIAL TRAVEL				
Travel a variety of specified routes	1	2	3	4
Reversing routes	1	2	3	4
Travel around a rectangular block	1	2	3	4
Cross residential streets	1	2	3	4
Cross 4 way stops	1	2	3	4
Cross in a clockwise direction	1	2	3	4

CONTESTANT'S NAME: _____

Cross in a counter-clockwise direction	1	2	3	4
Systematically relocate sidewalk	1	2	3	4
Reposition self on sidewalk and continue walking in desired direction	1	2	3	4
Use self correction techniques	1	2	3	4
Use appropriate cane techniques for moving around obstacles	1	2	3	4
Execute a route using directional instructions	1	2	3	4
Follow audio directions	1	2	3	4
Use landmarks for orientation	1	2	3	4

LIGHT BUSINESS and BUSINESS TRAVEL

Identify street layouts	1	2	3	4
Traffic patterns	1	2	3	4
Types of intersections	1	2	3	4
Cross at accessible signals	1	2	3	4
Cross signal intersections parallel to a major street	1	2	3	4
Identify the available sensory cues	1	2	3	4
Use appropriate cane techniques for negotiating obstacles	1	2	3	4
Solicit assistance for the purpose of orientation or making transactions	1	2	3	4
Locate a specified business	1	2	3	4
Locate, approach stairs both going up and going down, descend and ascend safely with appropriate cane skills	1	2	3	4

Trailblazers Only (grade 10-12)

Cross major signal intersections with left turn signals	1	2	3	4

Student's Signature: _____

Orientation and Mobility Specialist's Name: _____

Orientation and Mobility Specialist's Signature: _____

Date: _____

TRAINING SESSIONS FOR CANE QUEST FIELD ROUTES

Training for O&M Specialists

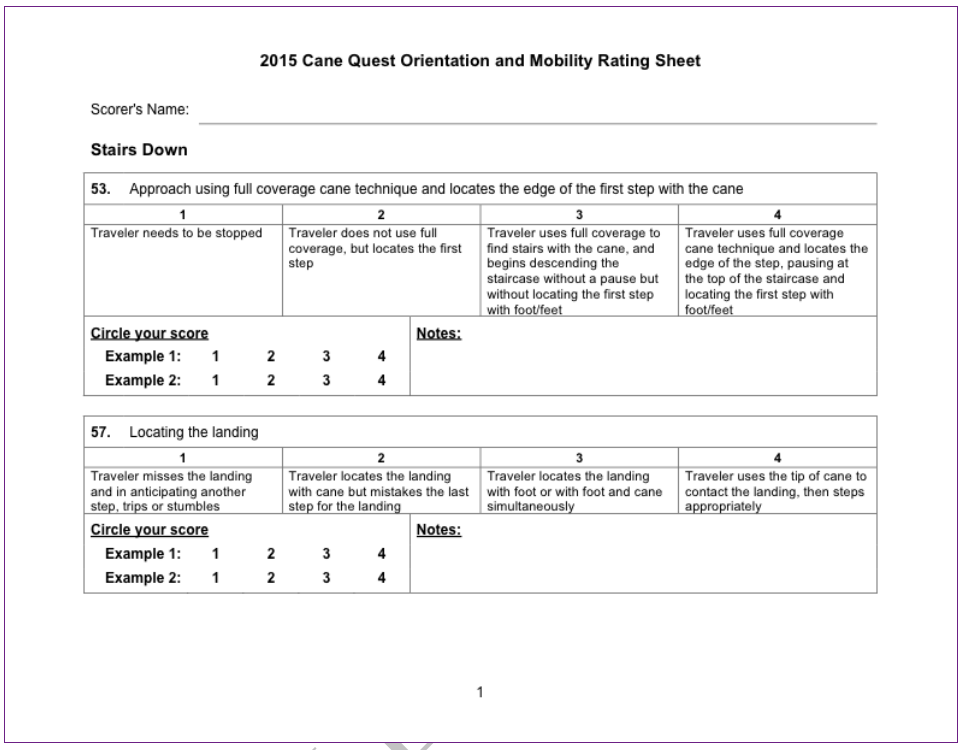
Scorers
Scoring for Cane Quest is somewhat subjective, so to make it as consistent as possible, O&Ms assigned to score contestants along the routes must go through a morning training session.

Materials Provided by BIA:

*O&M Scoring Video
*Scoring Video Rating Sheet
*Cane Quest Scoring Rubric **(to request Explorer/Trailblazer Rubric contact mjsaldivar@brailleinstitute.org)**

We recommend allowing for an hour-and-a-half session. O&Ms will watch separate segments of the scoring video. Each segment shows different students demonstrating a range of skill levels performing various Cane Quest tasks, such as crossing a street. Volunteer O&Ms will be asked to rate the student in the video segment on a scale of 1 to 4, according to the scoring rubric provided. The O&M Training Facilitator will ask for a consensus, then lead discussion about why professionals arrived at different scores. The Facilitator then shares the correct score value and rationale behind each score provided. Through this process, volunteers will understand the basis for Cane Quest scoring. This process also allows for inter-rater reliability for future research potential. This process helps ensure consistency in scoring.

O&M Training Video Rating Sheet - Sample:



2015 Cane Quest Orientation and Mobility Rating Sheet

Scorer's Name: _____

Stairs Down

53. Approach using full coverage cane technique and locates the edge of the first step with the cane			
1	**2**	**3**	**4**
Traveler needs to be stopped	Traveler does not use full coverage, but locates the first step	Traveler uses full coverage to find stairs with the cane, and begins descending the staircase without a pause but without locating the first step with foot/feet	Traveler uses full coverage cane technique and locates the edge of the step, pausing at the top of the staircase and locating the first step with foot/feet

Circle your score	**Notes:**
Example 1: 1 2 3 4	
Example 2: 1 2 3 4	

57. Locating the landing			
1	**2**	**3**	**4**
Traveler misses the landing and in anticipating another step, trips or stumbles	Traveler locates the landing with cane but mistakes the last step for the landing	Traveler locates the landing with foot or with foot and cane simultaneously	Traveler uses the tip of cane to contact the landing, then steps appropriately

Circle your score	**Notes:**
Example 1: 1 2 3 4	
Example 2: 1 2 3 4	

1

Training for Shadows

Shadows

Likewise, serving as a Cane Quest Shadow may also be somewhat subjective. Some volunteers have a tendency to want to "give too much help," while others may not know when they really should intervene. For this reason, it is VERY important that volunteer Shadows go through a training session.

Materials Provided by BIA:

*Shadow Training Video
*Cane Quest Contest Rules

An hour-and-a-half session is also recommended for Shadows. They will also watch separate segments of a training video. Each segment of the Shadow video gives an example of when contestants may need assistance, and demonstrates different interventions. The O&M providing

training will ask Shadows whether or not they felt the Shadow intervened correctly. The lead then shares the correct response and the rationale behind it. The lead also will go over the contest rules.

Training for Team Leaders

Team Leaders should be assigned several weeks in advance to attend a training and final walk-through before your event. This is essential for them to be oriented to the routes they will be doing and so they are clear where each route begins and ends.

They are in charge of one group of contestants for the entire day. It is their responsibility to:

*Make sure all contestants are present at the start of each route.
*Dispatch contestants at timed intervals to begin their route.
*Log the start time for each contestant.
*Make sure each contestant has a Bookport loaded with the correct route.

Materials Provided:

*A map of their route.
*A print copy of the audio instructions given to the contestants.
*Phone number to call for assistance.
*Names and stations of O&Ms on their routes.

Training for Station Leaders (Scout Route)

Station Leaders need to understand which skill(s) they will be scoring. This is important because key feedback will be given to the contestant and adult sighted guide as a way to promote fundamental O&M skills at an early age.

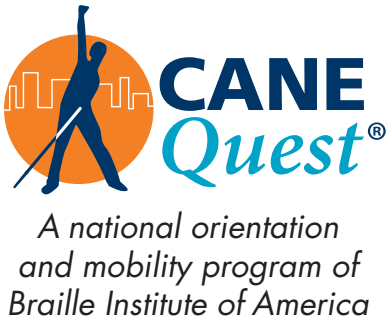
Materials Provided by BIA:

*Scout Course Scoring Video
*Scoring Video Rating Sheet
*Scout Scoring Rubric

During the suggested hour session, volunteers will watch separate segments of the Scout Course scoring video. Each segment shows different students demonstrating a range of skill levels performing various tasks, such as proper way to enter into a car. Volunteer Station Leaders will be asked to rate the student in the video segment on a scale of 1 to 4, according to the scoring rubric provided. The Scout Route Supervisor will

Contestant # _____ **Touch / Constant Contact / Congested Area Cane Techniques** **Checkpoint # _____**

1. Arm position	**1** Arm is not extended, elbow is hyper extended or bent, or arm is off to the side of the body	**2** Upper arm and forearm are locked in a straight position	**3** The arm and cane form almost a straight line (handshake position)	**4** Arm is slightly bent at the elbow, extended slightly away from the body, yet still in contact with the side of the body
2. Hand position	**1** Hand is outside of the width of the shoulder area, too high or low	**2** Hand is positioned at the side of the body	**3** Hand is positioned between navel and hip and is close to the body.	**4** Hand is positioned between the shoulders, around the height of naval and away from the body
3. Grip **Congested area grip**	**1** Fingers are clenched around the cane with no finger extended Same as above except hand is placed at bottom of grip	**2** Thumb or other fingers are extended, instead of the index finger, on the grip of the cane. Same as above except hand is placed at bottom of grip	**3** Index finger points downward but is on the top of the cane with downward pressure. Same as above except hand is placed at bottom of grip	**4** Index finger points downward on side of the cane grip, relaxed yet firm grasp (e.g. thumb is on top and gripped over the cane, while the middle and remaining fingers grip under the cane), hand is placed toward the top/center of the grip Same as above except hand is placed at the bottom of the grip
4. Wrist movement	**1** Wrist rolls (e.g. thumb/pointer rotate downward), wrist movement causes arm to move (e.g. elbow flaps with wrist movement)	**2** Forearm moves laterally	**3** Wrist rolls and forearm moves with upper arm stationary	**4** Hand moves back and forth laterally (e.g. thumb/pointer still facing up), wrist pivots independent of the arm
5. Arc width	**1** Missing coverage of either side of the body	**2** Appropriate on one side; but overly wide on the other side of the body	**3** Overly wide beyond 2 inches of shoulder width	**4** Within 2 inches of shoulder width 90% of the time
6. Arc height **Touch tech.** **Constant Contact**	**1** Above 3" from the ground On ground less than 25% of the time	**2** 3" above the ground On ground 25-75% of the time	**3** 2" above the ground On ground more than 75% of time	**4** 1" above the ground On ground 100% of the time
7. Rhythm and pace	**1** Over steps cane coverage or shuffles, AND has unusual balance, unusually slow pace, or unsteady gait	**2** Over steps cane coverage but the pace and gait are typical for walking and is balanced without breaking stride	**3** Not over stepping cane coverage; either pace is irregular or balance is unsteady; may break stride	**4** Not over stepping cane coverage; normal walking pace; doesn't break stride; balanced gait
8. In-step	**1** Less than 50% of the time	**2** 50-75% of the time; and does not self-correct	**3** 75-90% of the time; and self-corrects	**4** More than 90% of the time
9. Straight line of travel	**1** Less than 50% of the time	**2** 50-90% of the time; and does not correct	**3** 50-90% of the time; and self-corrects	**4** More than 90% of the time
10. Appropriate technique for area (e.g. touch technique, constant contact)	**1** Less than 50% of the time	**2** 50-90% of the time; and does not correct	**3** 75-90% of the time; and self-corrects	**4** More than 90% of the time



O&M Evaluation Form

Cane Quest 2015

Thank you for participating in Cane Quest! Please answer the questions below and submit your O&M Evaluation Form before the end of the day.

Training

The training prepared me to properly score and do my job for the day.	Strongly agree ☐	Agree ☐	Neutral ☐	Disagree ☐	Strongly disagree ☐
The job assignment was clear and easy to understand.	☐	☐	☐	☐	☐
The training video was helpful and easy to follow.	☐	☐	☐	☐	☐
Overall, how would you rate the training?	Excellent ☐	Good ☐	Average ☐	Poor ☐	Very poor ☐

What aspects of training could be improved?

_____

_____

_____

_____

Routes and Scoring

The shotgun start approach was efficient.	Strongly agree ☐	Agree ☐	Neutral ☐	Disagree ☐	Strongly disagree ☐
The scoring rubric was clear and easy to follow.	☐	☐	☐	☐	☐
The route was challenging.	☐	☐	☐	☐	☐

What aspects of the route could be improved?

_____

_____

_____

_____

Is there a specific checkpoint that is too challenging or too easy for contestants?
If so, please explain:

_____

_____

_____

_____

How could BIA best support the recruitment efforts of O&MS?

_____

_____

_____

_____

Additional Comments/Suggestions:

How can we make Cane Quest more appealing for students and O&Ms?

_____

_____

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