Kirchner, C., Johnson, G., & Harkins, D. (1977). Research to improve vocational rehabilitation: Employment barriers and strategies for clients who are blind or visually impaired. *Journal of Visual Impairment & Blindness, 91*, 377–392.

McDonnall, M. C. (2014). Employer attitudes towards blind or visually impaired employees: Initial development of a measurement instrument. *Rehabilitation Counseling Bulletin, 58*(1), 29–36.

McDonnall, M. C. (2017). Additional evidence for the validity of the Employer Attitudes toward Blind Employees Scale. *Rehabilitation Counseling Bulletin, 60*(3), 155–162.

McDonnall, M. C., O'Mally, J., & Crudden, A. (2014). Employer knowledge of and attitudes towards individuals who are blind or visually impaired. *Journal of Visual Impairment & Blindness, 108*(3), 213–225.

Michele Capella McDonnall, Ph.D., CRC, *research professor and director, The National Research & Training Center on Blindness & Low Vision, Mississippi State University, P.O. Box 6189, Mississippi State, MS 39762; e-mail: m.mcdonnall@msstate.edu.*

An Approach to Using Orientation and Mobility (O&M) Variables from the Second National Longitudinal Transition Study

Lydia Schuck, Robert Wall Emerson, Dae Shik Kim, and Nickola Wolf Nelson

The study reported here examined eight variables of the *Teaching Age-Appropriate Personal Skills* (TAPS) checklist (Pogrund et al., 1995). The goal was to identify potential orientation and mobility (O&M) factors to represent constructs underlying the data that could be used in the future to better research the college readiness of youths who are visually impaired (that is, those who are blind or have low vision). In order to carry out such an analysis, a dataset with a large number of participants is needed. The TAPS checklist referred to in this investigation was administered to youths ages 15 and 16 years as part of the second National Longitudinal Transition Study (NLTS2), a large study carried out from 2000 to 2010 (SRI International, 2000). We used an exploratory factor analysis, a statistical technique that accounts for shared variance between variables in a population of interest, to reduce the number of variables in a large collection of data.

Two broad categories of youth characteristics may affect the adult outcomes of youths who are visually impaired. Some of the differences in adult outcomes between students with and without disabilities may be tied to demographic- and disability-related characteristics; others are possibly tied to student experiences and skills (Blackorby, Hancock, & Siegel, 1993; Newman et al., 2011). Demographic and disability characteristics may be considered risk factors that would identify a student as a candidate for receiving additional support services in a college context.

In contrast, student experiences and skills can be addressed by educational intervention, which has implications for planning during the school years. Some of these interventions address the needs of students who are visually impaired beyond the core curriculum in which all students receive instruction. O&M training is often one of the interventions provided to these students.

The data in this study were collected as part of the NLTS2 using a checklist found in the second edition of the widely used TAPS (Pogrund et al., 1995) O&M curriculum. Cameto and Nagle (2007) found no differences in O&M skills among NLTS2 participants related to age, gender, or race or ethnicity. However, they noted that youths whose families had higher incomes were better at soliciting help inside a building than those with middle or lower socioeconomic status. Being visually impaired, not totally blind, and having no additional disabilities were both associated with better O&M skills in the same study.

Receipt of O&M instruction was positively associated with attending postsecondary education up to four years after high school, but not in data collected two years later (Wolffe & Kelly, 2011). Cmar (2015) analyzed both the TAPS items and several other community travel variables in the NLTS2, finding that youths with high travel scores were more likely to be employed when data were collected again several years later.

The NLTS2, a particularly rich source of information about youths with many kinds of disabilities, was designed by SRI (formerly Stanford Research Institute) International (2000) to gather data for approximately 10,000 youths over 10 years old, among them approximately 820 visually impaired youths. When working with a dataset that includes both a large sample size and a large number of variables, as does the NLTS2, it is appropriate to consider scientific techniques to reduce the number of variables to make them more manageable (Field, 2009; IBM, 2012: Kline, 1994). One approach to such a large dataset is to sum the scales that are embedded in the data, similar to the approach used by Cmar (2015). However, this approach may obscure important variance between the items in the scale. The present study applied an exploratory factor analysis (Field, 2009; Kline, 1994; Thompson, 2004). Factors that represent hypothesized latent constructs are created from groups of variables, together explaining shared variance found among the variables. Exploratory factor analysis simplifies the data structure for subsequent research, while offering opportunities to explore the underlying structure of the data (Thompson, 2004).

Blackorby et al. (1993) identified factors in data collected in the first NLTS study, which were then used in a regression analysis of young adult outcomes. No similar research has been found that related specifically to O&M skills or that used the data from the NLTS2. The authors of the present study hypothesized that O&M skills data might form factors that could be used in future research to investigate adult outcomes experienced by youths who are visually impaired.

As a result of the search of background literature, this study was designed to answer the following question:

> What teacher-reported O&M skills variables (measured for visually impaired 16- to 18-year-olds) from the NLTS2 dataset may be empirically verified as factors representing latent constructs potentially associated with college and career readiness?

Methods

Data source

O&M variables from the school context of students who are visually impaired were identified in the NLTS2 dataset. Only the descriptive data presented here were weighted to make the data representative of the actual population proportions. Weighting is not necessary in factor analysis procedures.

The Human Subjects Institutional Review Board of Western Michigan University approved this secondary analysis study prior to the beginning of the present investigation. The authors of this study were authorized users of the dataset.

Participants

All participants had visual impairment as their primary special education diagnosis. However, the sample was limited to those who were able to participate in a direct assessment of self-determination, self-concept, and academic achievement that was part of the NLTS2 data collection (SRI International, 2000). This method yielded a sample of students who were considered likely to be eligible for college enrollment. Approximately 410 visually impaired NLTS2 participants met the inclusion criteria.

Table 1
Description of sample.

Descriptor	Percent of sample
Gender (n = 410)	
Male	49.5
Female	50.5
Race (n = 410)	
White	62.8
African American	19.7
Hispanic	13.6
Asian or Pacific Islander	2.5
Alaska native or native American	0.6
Multi-race or other	0.8
Income (n = 380)	
$25,000 or under	30.6
$25,001 to $50,000	32.2
Over $50,000	37.2
Assessed in braille (n = 410)	
0 No	79.8
1 Yes	20.2
Assessed in large print (n = 410)	
0 No	73.4
1 Yes	26.6
Received O&M (n = 410)	
0 No	43.4
1 Yes	56.6
Additional disability (n = 410)	
0 No	73.2
1 Yes	26.8

A sample of at least 300 cases is usually required to perform an exploratory factor analysis (Field, 2009; Thompson, 2004). Although the sample sizes of the remaining eight items were lower than 300, the authors considered the research important enough to continue.

Demographic and disability-descriptive variables

The descriptive data were weighted using the Complex Samples module of SPSS 22 to reflect the effects of the sampling plan of the NLTS2. Table 1 displays the descriptive variables and their frequencies in the complete sample of approximately 410 cases.

TAPS checklist items

Some NLTS2 variables measure skill areas in which students might still respond dynamically in the future to instruction, such as O&M. For the NLTS2, a teacher in each participant's school recorded the O&M skills of students using the On-Campus Orientation and Mobility Skills list from *Teaching Age-Appropriate Purposeful Skills* (TAPS; Pogrund et al., 1995). The TAPS checklist used in the NLTS2 originally included 10 items. Since a sample of at least 300 cases is typically required to perform an exploratory factory analysis (Field, 2009; Thompson, 2004), 2 were omitted from the analysis because their sample sizes were approximately 120. Although the sample sizes of the remaining 8 items were 180, the authors considered the research important enough to continue. The 2 variables that were removed from analysis recorded the ability of the student to solicit help to become oriented in a building and on a school campus or workplace. In a familiar setting like a participant's school, it would be difficult to observe the student soliciting help. It is thus not surprising that these skills were observed less frequently and that the variables could not be maintained in the analysis. The remaining eight items measured indoor skills that were easily observed on a school campus, as listed (note that the TAPS curriculum does not suggest any division of the checklist into different levels of skills):

(a) travels using a sighted guide to familiar locations,
(b) travels indoors using routes learned by rote,
(c) travels to other areas using routes learned by rote,
(d) creates new routes between familiar places indoors,
(e) executes a route within a building with verbal directions,
(f) executes a route in another building with verbal directions,

(g) locates an unfamiliar place by numbering systems, and
(h) orients self to an unfamiliar room.

Exploratory factor analysis compares shared variance among a group of variables and a group of participants, potentially providing insight into latent structures underlying the observed data. No outcome variable is used in factor analysis. The present analysis considered only the remaining eight TAPS variables and the data collected for 180 participants when they were between 15 and 16 years old.

Analysis and Results

Factor analysis: phase one

The analyses were performed using the Statistical Package for the Social Sciences, version 22. Appropriate packages from the *R* statistical environment were downloaded and used within the SPSS analyses.

The authors examined correlations among the data using heterogeneous correlation function (HETCOR) of SPSS 22, appropriate for ordinal (ordered categorical) data. Correlation at $r = .3$ or above is an accepted level to maintain the inclusion of a variable for factor analysis (Thompson, 2004). All eight variables correlated with each other at or above $r = .3$, with one exception. The pairing of item (a) with item (g) had $r = .198$. However, since each of these two items correlated with all the others at or over $r = .3$, items (a) and (g) were retained for the exploratory factor analysis.

Factor analysis: phase two

The second general phase of the analysis was the derivation of the factor solution. This phase included determining the correct number of factors to be derived, identifying an initial factor solution, and rotating the solution to derive a simple factor solution that accounted for all of the variables. The authors used a two-step polychoric analysis and principle components procedure to create the initial solution. We determined the correct number of factors to retain in the final solution using a scree plot, Velicer's MAP analysis, and the Very Simple Structure test.

A number of initial solutions and rotations were tried. The authors selected a quartimin rotation that generated a solution that was logical and simple (Thompson, 2008), and that completely separated the factors. In future research, each factor can be used as a single continuous level variable, reflecting the portions of the factor contributed by each variable. Each factor takes on the sum of the products of the pattern coefficients multiplied by their respective variable values for each case within the data.

Two factors emerged from the analyses. For the factor "Practicing skills in familiar settings," (Practicing) represents items (a) through (c) and accounts for 70.38% of the shared variance among the items. The factor "Generalizing skills in novel settings" (Generalizing) represents items (d) through (h) and accounts for 86.56% of shared variance. Using the pattern coefficients generated by the analysis in and the values of variables (a) through (h) recorded in the data, the two factors are created as follows for each participant:

$$\text{Generalizing} = 1.029g + .972f + .866e + .839d + .693h$$

$$\text{Practicing} = .910a + .889b + .638c$$

The two new factor variables can be calculated and entered into the dataset for use in further analyses among the same set of participants, or to quantify an individual student's skills.

Discussion

Analysis of the eight TAPS items resulted in two factors. The factor Practicing captured three variables related to rote learning and

greater support from an O&M professional. The factor Generalizing comprised five variables measuring skills in new settings and with a lower level of support from the instructor. These two factors may seem to be obvious, but this analysis is entirely new. Previous studies have only used a sum of the checklist with or without adding in other community travel values in the dataset, or ignored the TAPS data and used only the yes-or-no O&M variable found in the descriptive data. The present analysis justifies using just two variables to represent the TAPS scale in future research. Having just two variables to represent a group of eight is especially useful in regression analyses, which is an appropriate analytical approach to longitudinal data such as the NLTS2 data. The two factors reflect portions of shared variance, making each of them more meaningful than the eight single variables or a single-scale sum variable.

The results of the study are limited by a sample size that was smaller than the 300 cases recommended for an exploratory factor analysis (Field, 2009; Thompson, 2004). However, data on TAPS are rarely presented even in as large a group as offered by NLTS2. For this reason, the authors conducted this first exploratory factor analysis of TAPS data. The fact that TAPS O&M skills were not necessarily recorded by an O&M professional is noted as a limitation in the data collection plan.

Practical implications and further research

Further research is recommended. The two factors identified could be applied with outcome variables among youths with visual impairments in the NLTS2 dataset. Using two factors rather than eight variables makes it possible to perform analyses with smaller sample sizes, critical in the study of low-incidence disabilities such as visual impairments. This approach for working with smaller sample sizes in the future is possibly the most important contribution of this research approach to the current literature.

The results might also be used to assist the work of O&M instructors working in rehabilitation and education. After scoring the eight TAPS items for an individual, O&M instructors could use the two factors, Practicing and Generalizing, to quantify the level of training still needed by each student. Students with high scores on the Practicing factor might only need opportunities to generalize their basic skills. Those who have high scores on both factors would potentially need only a checkup on their skills. As part of a comprehensive skill review, the TAPS factors could be used to identify students who need additional support from an O&M instructor.

References

Blackorby, J., Hancock, G. R., & Siegel, S. (1993). *Human capital and structural explanations of post-school success for youth with disabilities: A latent variable exploration of the National Longitudinal Transition Study.* Menlo Park, CA: SRI International. doi:10.1037/e601272011-001

Cameto, R., & Nagle, K. (2007). *Facts from NLTS2: Orientation and mobility skills of secondary school students with visual impairments*. Menlo Park, CA: SRI International.

Cmar, J. (2015). Orientation and mobility skills and outcome expectations as predictors of employment for young adults with visual impairments. *Journal of Visual Impairment & Blindness, 109*(2), 95–106.

Field, A. (2009). *Discovering statistics using SPSS.* Los Angeles, CA: Sage.

IBM. (2012). *IBM SPSS Statistics Base 22.* Retrieved from ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/22.0/en/client/Manuals/IBM_SPSS_Statistics_Base.pdf

Kline, P. (1994). *An easy guide to factor analysis.* London, UK: Routledge.

Newman, L., Wagner, M., Knokey, A.-M., Marder, C., Nagle, K., Shaver, D., . . . Schwarting, M. (2011). *The post-high*

school outcomes of young adults with disabilities up to 8 years after high school. A report from the National Longitudinal Transition Study-2 (NLTS-2) (NCSER 2011-3005). Menlo Park, CA: SRI International. Retrieved from http://www.nlts2.org/reports

Pogrund, R., Sewell, D., Anderson, H., Calaci, L., Faith Cowart, M., Gonzalez, C., . . . Roberson-Smith, B. (1995). *Teaching age-appropriate purposeful skills: An orientation and mobility curriculum for students with visual impairments*. Austin, TX: Texas School for the Blind and Visually Impaired.

SRI International. (2000). *National Longitudinal Transition Study-2 (NLTS-2): Study design, timeline and data collection plan*. Menlo Park, CA: Author.

Thompson, B. (2004). *Exploratory and confirmatory factor analysis: Understanding concepts and applications.* Washington, DC: American Psychological Association.

Wolffe, K., & Kelly, S. M. (2011). Instruction in areas of the expanded core curriculum linked to transition outcomes for students with visual impairments. *Journal of Visual Impairment & Blindness, 105*(6) 340–349.

Lydia Schuck, Ph.D., *instructional designer, Department of Curricular Affairs, Hadley Institute for the Blind and Visually Impaired, 700 Elm Street, Winnetka, IL 60093; e-mail: lydia.a.schuck@wmich.edu.* ***Robert Wall Emerson, Ph.D.,*** *professor, Department of Blindness and Low Vision Studies, Western Michigan University, 1903 West Michigan Avenue, Kalamazoo, MI 49008; e-mail: robert.wall@wmich.edu.* ***Dae Shik Kim, Ph.D.,*** *associate professor, Department of Blindness and Low Vision Studies, Western Michigan University, Kalamazoo, MI; e-mail: dae.kim@wmich.edu.* ***Nickola Wolf Nelson, Ph.D.,*** *professor emerita, Department of Speech, Language, and Hearing Sciences, Western Michigan University; mailing address: 58995 Camp Wakeshma Road, Three Rivers, MI 49093; e-mail: nickola.nelson@wmich.edu.*

