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Research Report

Evaluation in the Older Blind Independent Living Program: Advantages of a Structural Equation Modeling Approach

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The U.S. Office of Management and Budget (OMB) developed the Program Assessment Rating Tool (PART) in 2002 to assess performance of federal programs, develop program improvement plans, and link program performance to budget decisions. PART strengthened the Government Performance and Results Act (GPRA) of 1993 by including in the PART evaluation process the program goals and performance measures developed under GPRA by the different Federal programs. Under this system, program managers and their advocates must develop performance goals that focus on program outcomes and develop valid instruments to measure outcomes accurately. This latter area is our concern.

At the end of 2005, OMB had reviewed approximately 80% of federal programs and had projected completion of the remaining program assessments by the end of 2006 or early 2007 (ExpectMore.gov, n.d.). The Older Blind Independent Living

Program, initially funded in FY1987 by the Rehabilitation Services Administration (RSA), will be among the last of the programs reviewed by OMB. This program provides services to individuals aged 55 and older whose significant visual impairment makes competitive employment very difficult, but for whom independent living goals are feasible. The program serves approximately 62,000 consumers nationally through 56 independent living agencies in states and territories (Moore, Steinman, Giesen, & Frank, 2006). The state independent living programs offer blindness and low-vision services such as training in orientation and mobility, communications, and daily living skills.

RSA requires that independent living programs annually report demographic information on consumers receiving services and the numbers receiving specific types of services. Although some states collect information on consumer outcomes (for example, improvement in daily living skills), RSA does not request such data. After being vacant for the last three years, the RSA independent living program manager position is currently being filled as of July 2006. We expect that a major priority of the new manager will be the development of program goals and performance measures that can be used to demonstrate program effectiveness.

RSA has supported two national surveys of functional outcomes and consumer satisfaction among those served by the Older Blind Independent Living Program (for example, Moore et al., 2006). The most recent of these surveys was conducted in 2004. Although its data may be too old to be used in any OMB evaluation, perceived functional outcomes were highly positive and overall satisfaction of consumers was high (over 90%). Results from the evaluation instrument were reported mostly on an individual-item basis. Although the survey questionnaire was carefully developed, its dimensionality and psychometric properties as an instrument have not been intensively investigated. It is important that any assessment tool used to

collect outcome data be continually evaluated and refined. In the current political climate, where disability-specific programs continue to be at risk (F. Schroeder, personal communication, April 26, 2006), survival of programs serving blind and visually impaired consumers may depend on the initiative and rigor of administrators in demonstrating that their programs are effective. Thus, the present study focuses on improvement of measurement quality and consideration of additional methodological approaches to evaluation of national services to persons who are blind or visually impaired.

In addition to traditional methods of instrument development (for example, internal consistency reliability analysis, exploratory factor analysis), covariance structure analysis (CSA) or structural equation modeling (SEM) was employed. SEM methods have a variety of advantages, including rigorous evaluation of a measurement factor model, ability to address item measurement error correlations, and ability to address direct and indirect effects in a structural model (Kelloway, 1998). A secondary purpose of this study is to demonstrate how CSA can contribute substantively to the examination of relationships among measured constructs, specifically program effectiveness: how improvements in blindness and low-vision rehabilitation skills can positively affect other activities of daily living (ADL) related to functioning and satisfaction, as suggested by Cavenaugh and Steinman (2005) and implied by general rehabilitation theory (Arokiasamy, 1993).

Method

Data source and instrument

Data were from a national survey of functional outcomes and satisfaction among 1,025 consumers in the Older Blind Independent Living Program (Moore et al., 2006). Due to respondents' considerable use of the "Not Applicable" alternative, complete data were available for 603 respondents on the 10 survey items of interest. The survey instrument was

designed to obtain information on perceived outcome and satisfaction specific to the impact of independent living services on older individuals who are blind and are served under Title VII-Chapter 2. Items were developed with the assistance of an expert panel, with attention to domain content validity, and were pretested in four states.

The specific wording for the items and response scales is given in Table 1. Based on face validity, items were intended to tap domains of respondents' confidence in areas of activity and mobility: ADLs (Items 1-4); print access or vision use (Items 5-6); community integration (Item 7); and satisfaction (Items 8-10). The entire scale was subjected to exploratory factor analysis, internal consistency reliability analysis of factors, confirmatory factor analysis, and latent factor modeling using LISREL 8.7, a statistical program (Jöreskog & Sörbom, 2005).

Results

Distributional examination of variables indicated acceptable results except for some negative skew for Items 8 and 9 (Satqua8 and Satim9). Multivariate normality on the set of variables was tested using PRELIS 2.7, a companion program to LISREL 8.7 (Jöreskog & Sörbom, 2005). The resulting Mardia's coefficient of 1.49 indicated that multivariate normality was not violated. Exploratory principal components analysis and principal axis factoring using oblimin (nonorthogonal) rotation yielded three factors: general ADL (Items 1-4, 7) satisfaction (Items 8-10), and vision use (Items 5-6). Cronbach's alphas were .80, .79, and .77, respectively, with very little change in alpha if specific items in the scale set were deleted.

CSA typically involves development of a "measurement model" and then specification of a structural model that describes linkages between the (latent) factors. Using correlation matrix input, a three-factor measurement model (or confirmatory factor analysis) was specified using Items 1-4 and item 7 as reflective

indicators of ADL improvement (ADLIMP), Items 5-6 for vision use improvement (READ), and Items 8-10 for satisfaction with independent living program services (SATISFAC). An advantage of the CSA model is that the measurement error of an indicator can be separated from its variance explained by the factor on which it has a substantial factor loading. In addition, correlations between item measurement errors also can be assessed.

Item 2 (Move2) was dropped from the measurement model analysis because of cross-loading tendency and error correlation with Item 1 (Prfact1). Further examination of diagnostics (standardized residuals and modification indices) indicated that the fit of the confirmatory factor model could be improved. Measurement errors for Items 8 and 9 (Satqua8 and Satim9), and for Items 3 and 4 (Meal3 and Houkep4) were allowed to correlate because of item wording and logical similarities. The final measurement model was a first-order confirmatory factor analysis model with correlated factors: SATISFAC - ADLIMP = .68, SATISFAC - READ = .36, ADLIMP - READ = .59, all $p < .05$. Construct reliabilities for SATISFAC, READ, and ADLIMP were .77, .77, and .75, respectively.

Several structural models were examined, including a primary and two alternative models. (Another advantage of CSA is that the regression relationships between factors in the structural model are analogous to relationships between "true scores" on the factors; the relationships have been corrected for attenuation due to measurement error.) The primary interest Model 1 postulates that vision-use improvement (READ, $\xi 1$) directly influences the endogenous latent constructs of ADL improvement (ADLIMP, $\eta 2$) and satisfaction (SATISFAC, $\eta 1$), and that ADL improvement in turn influences satisfaction. The final standardized Model 1, with measurement errors, loading, and regression path estimates shown in Figure 1, achieved good fit: $\chi^2(22) = 60.94$, $p < .0001$; RMSEA = 0.0542; p for Close Fit (RMSEA < .05) = .311; GFI = 0.978; AGFI = 0.955. The only

nonsignificant path was to SATISFAC from READ (γ_{11} = -0.07).

Overall, 47.2% of variance in program satisfaction and 34.8% of the variance in ADL improvement were explained by the model. All of the effect of vision-use improvement on program satisfaction was indirect, mediated through ADL improvement.

An alternative Model 2 was the same as Model 1 except that there was no path between ADL improvement and program satisfaction. This model was examined to consider results that might be obtained from a simple multivariate regression model (READ predicting SATISFAC and ADLIMP) without an indirect effect path. Model 2 fit was unacceptable: $\chi^2(23) = 164.3$, $p < .00001$; RMSEA = 0.101; p for Close Fit (RMSEA < .05) = .000; GFI = 0.943; AGFI = 0.888. Diagnostics (largest modification indices) indicated the need for a path between ADL improvement and program satisfaction in either direction.

Alternative Model 3 was the same as Model 1 except that the direction of the indirect effect path was intentionally reversed: to ADL improvement from program satisfaction--a possibility suggested by the modification indices obtained from Model 2. Model 3 fit was good, with fit statistics identical to those for Model 1, as were all measurement model parameter estimates. However, the structural path coefficients were quite different: γ_{11} (SATISFAC from READ) = .36, γ_{21} (ADLIMP from READ) = .39, and β_{12} (ADLIMP from SATISFAC) = .54, all $p < .05$.

Discussion

Based on exploratory factor analysis, the independent living survey instrument was found to measure three factors: satisfaction with program services, general improvement in ADLs, and improvement in vision use or reading. Factor alpha reliabilities were acceptable. Little other useful information regarding instrument refinement or improvement was gleaned

from traditional reliability analysis.

Covariance structure analysis did provide additional useful information regarding the instrument and substantive interpretation of the relationships between constructs measured by the instrument. The loadings of the items on the factors and their error variances can help distinguish those items that are doing a good job measuring the factor or construct they reflect from those that have high measurement error or are measuring some unknown factor. For example, as shown in Figure 1, most of the variance in item 5 (managing paperwork--loading of $.84^2$ = 71%--is associated with the vision-use improvement factor, indicating a satisfactory item. In contrast, item 4 (managing housekeeping tasks)--loading of .632 = 40%--has less than half of its variance associated with the ADL improvement factor, suggesting that the item is weak because 60% of its variance is associated with error of measurement or other unknown influences. Such information is useful in targeting items for improvement. Based on high item-error variance and tendency for an item to load on more than one factor (cross-loading), we recommend that the item dealing with being "better able to move confidently around where I live" be removed from the instrument, possibly to be replaced with an item that is likely to be more effective in measuring ADL improvement. Other items with loadings of less than .7 also are candidates for improvement or replacement.

Measurement model analysis also provides information about redundant items as indicated by correlations between their errors of measurement. We found this tendency for satisfaction in Items 8 (service quality) and 9 (timeliness), and independent living Items 3 (prepare meals) and 4 (manage housekeeping tasks), which should be revised to avoid similar (redundant) responding tendencies.

Covariance structure analysis has limitations. Coovert, Penner, and MacCallum (1990) characterized the goodness-of-fit

information provided by this methodology as indicating the (statistical) plausibility of a model. In addition to confirmation of Model 1 (Figure 1), our analysis indicates that our data also fit (confirm the plausibility) of a causally irrational model that postulates improvement in vision use directly affects satisfaction, which, in turn, affects ADL improvement. Clearly, covariance structure analysis is a useful analytic tool, but plausible theory is an essential accompanying component for interpretation of results.

Summary

In summary, the structural relationships between the latent constructs measured by the instrument provide useful substantive information beyond measurement issues. Our postulated conceptual model was that improvement in print access and vision-related tasks--presumably from independent living services--affected ADL functioning and satisfaction with services. This model is derived from a general theory of rehabilitation in which interventions are expected to have positive functional effects for the individual (Arokiasamy, 1993). Model results support the theory, indicate that the national Older Blind Independent Living Program is effective, and suggest that the vision-related intervention effect is not direct, but mediated. Vision-use improvement affects improvement in ADL functioning, which, in turn, leads to consumer satisfaction. If we had found that there was no significant effect (path) of improvement in vision use on ADL functioning, or no effect from ADL functioning to satisfaction, program effectiveness might be questioned. (We have seen such data [Giesen, 2006].) Thus, by thinking of (and modeling) the process by which independent program services affect satisfaction, we hope to add an additional dimension to measurement of program effectiveness and contribute to efforts that add a greater understanding of how and why program interventions work.

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