Issues in the Intellectual Assessment of Hearing Impaired Children

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Abstract

The assessment of hearing impaired children is fraught with a number of problems. These include lack of valid assessment measures, faulty theoretical assumptions, lack of knowledge regarding the functioning of cognitive processes of these children, and biases against these children. This article briefly considers these issues and describes a study conducted with hearing impaired children. To examine these issues, scores on the Universal Nonverbal Intelligence Test were compared with Wechsler Intelligence Scale for Children-III Performance IQs. Subjects were 32 hearing-impaired residents of a state school for the deaf. Analyses indicated 1) all UNIT IQs and WISC-III PIQs were attenuated, and 2) mean UNIT IQs and PIQs did not differ for the total sample or by gender but were significantly different for a sub sample of middle school students. The inter-correlations among UNIT IQs and WISC-III PIQs and subtests were high (median r =.723), indicating that the UNIT FSIQs and WISC-III IQs share considerable conceptual overlap.

Conducting valid cognitive assessments of hearing impaired children has long been considered problematic. Barriers have included faulty theoretical assumptions, implicit biases, and methodological errors (Blennerhassett & Trexler, l999; Chavaz, l998; Krivitski, 2000). One consequence of using flawed assessment strategies has been a perception that hearing impaired children are intellectually inferior to their hearing peers. Only recently has this assumption been challenged; however, the literature does indicate that these children often present with lower cognitive ability scores than do hearing children. Specifically, studies by Phelps and Branyan (l988) and Slate and Fawcett (l996) using scores from the Leiter, the WISC-R and the WISC-III confirmed these differences. One explanation for these findings is that the etiologies of profound hearing loss are also associated with other neurological impairments that frequently interfere with the functioning of cognitive processes (Sattler, l992). Hearing impaired children also demonstrate delayed language development when compared with hearing peers and score lower than hearing children on academic assessments, even when presenting with average levels of intelligence (Braden, l992). Deficits in vocabulary and language development have also been associated with low reading ability, which may impact academic achievement of hearing impaired children negatively (Mayne, Yoshinaga-Itano, Sedley, & Carey, 1999).

A primary impediment to valid assessment is that there are relatively few cognitive assessment instruments deemed appropriate for the hearing impaired (Sattler, 2001). Among the most popular are the Wechsler Intelligence Scale for Children, Third Edition (WISC-III) and the Wechsler Adult Intelligence Scale, Second Edition (WAIS-II), (Braden &

Hannah, l998; Brauer, Braden, Pollard, & Hardy-Braz, l998). Specifically, the subtests comprising the Performance Scale are often purported to be more valid overall indicators of cognitive ability (Maller & Braden, l993; Blennerhassert & Traxler, l999). However, while these scales boast superior psychometric properties, the verbal requirements of the test may produce IQ scores for the hearing impaired which underestimate or misrepresent actual cognitive ability (Bracken & McCallum, l998).

Another challenge in evaluating cognitive abilities of hearing impaired children lies in differentiating linguistic competence from other areas of cognitive functioning. One functional way to separate intellectual ability from language acquisition is to use language-reduced or nonverbal tests of intelligence (Brauer, et al, l998). Cognitive assessment measures that require a child to either comprehend directions or provide a verbal response may yield useful information regarding verbal skills development but may be of limited value for assessing the quality of the child's thinking and reasoning abilities (Mullen, l999).

Two major types of tests: Performance tests and nonverbal tests are commonly used in the assessment of hearing impaired children. They differ in the way in which they are administered, as performance tests typically involve verbal instructions by the examiner and nonverbal responses by the examinee. Nonverbal measures are administered typically through gesture and/or pantomime and require nonverbal responses from examinees (Krivitski, 2000). There are two types of nonverbal tests-- tests that require children to manipulate objects, e.g., the Cube Design subtest of the WISC-III and motor-free tests that do not require children to manipulate objects, e.g., Raven Progressive Matrices. While IQ scores of hearing impaired children often are lower than those of hearing children, Brauer, et al (l998) reported that their scores on performance and motor-free nonverbal intelligence tests are usually in the average range. It is noteworthy that they do tend to score lower on motor-free nonverbal tests than on performance tests.

One measure that was developed in response to the issues discussed above is the Universal Nonverbal Intelligence Test (UNIT; Bracken & McCallum, l998). This scale is a completely nonverbal individualized scale designed for children ages 5 to 17 years. Test administration requires the use of eight standardized gestures and appropriate modes of administration which are modeled in a video available from the publisher.

Among the limited number of studies in the literature comparing cognitive ability scores of hearing children versus hearing impaired children, Bracken and McCallum (l998) compared UNIT scores for a sample of 106 hearing impaired individuals. UNIT mean score differences ranged from 3.50 (Abbreviated Battery) to 8.01 (Extended Battery). The FSIQ mean differences were 3.59, 6.20, and 8.01, respectively, for the Abbreviated, Standard, and Extended batteries. These differences are about a one-third standard deviation (in favor of the hearing examinees) and are considerably smaller than would be expected on language-loaded tests).

Another study, (Krivitski, 2000) examined whether hearing impaired children performed similarly to hearing children on the UNIT. The author compiled a sample of hearing impaired students that matched the standardization sample of hearing children on age, gender, race/ethnicity, and parental education level. The results of the profile analysis found that deaf and hearing children display similar patterns of performance on the subtests of the UNIT. This outcome supported the use of the UNIT for assessment of the cognitive abilities of deaf children.

Given that there is limited relevant research, this study contributes to the current literature in the following ways: First, it employs a within subjects design in which deaf students are administered two popular intellectual assessments; second, it uses well-validated instruments; third, it includes an analysis of various levels of the independent variables of grade level and gender; and fourth, it contributes to the existing data by focusing on a specific low incidence population -- the hearing impaired. This study also contributes to a body of evidence regarding the degree to which cognitive assessment tools may function differentially when administered to hard of hearing children and adults.

The primary objective of this study was to compare the relationship of UNIT IQs and WISC-III PIQs when administered to hearing impaired students. Given that the UNIT is administered without language, it was predicted that scores on the UNIT would be higher than those on the WISC-III. A secondary objective was to examine the effect of grade level and gender on test performance of selected hearing impaired students.

Method

Subjects were 32 residents (15 girls, 17 boys) recruited from a state school for the deaf. Selection criteria were these: ages ranged from six to sixteen and hearing loss fell in the severe to profound range (60dB). Twenty of the subjects attended middle school and twelve, primary school. Participation was not limited by grade level or gender. All referred students with signed consent forms were included when possible.

Four of the six subtests of the UNIT, Symbolic Memory, Cube Design, Spatial Memory, and Analogic Reasoning, and the six subtests comprising the Performance Scale on the WISC-III. Picture Completion, Coding, Picture Arrangement, Block Design, Object Assembly, and Digit Span, were administered in counterbalanced order by the senior author within a three week period. The order of the participants was randomized to control for any confounding.

Instruments

The Universal Nonverbal Intelligence Test (UNIT) is a multidimensional measure of general intelligence designed for children and adolescents ages five to seventeen years. The test consists of nonverbal stimuli and uses a response administration format that incorporates gestures and demonstrations. The scale was developed to assist practitioners who serve children and adolescents whose cognitive and intellectual abilities cannot be appropriately assessed with language-loaded or existing unidimensional nonverbal measures (Braden & McCallum, l998). The construct of intelligence is defined as the capability to solve problems using memory and reasoning that is predictive of an individual's ability to learn and think about new and familiar situations (Bracken and McCallum, 1998). The deaf and hard of hearing examinees are predicted to achieve higher scores on the UNIT than on verbally loaded cognitive measures and on tests requiring limited examinee participation.

The UNIT offers three testing options, including the Abbreviated, Standard and Extended batteries that require from 15 to 45 minutes. It consists of six subtests that assess a broad range of complex memory and reasoning abilities including those lending themselves to internal processes of verbal (symbolic) mediation as well as those that are less conducive to such mediation (nonsymbolic). These subtests- Symbolic Memory, Cube Design, Spatial Memory, Analogic Reasoning, Object Memory, and Mazes -- are organized into the following four quotients: Memory, Reasoning, Symbolic, and Nonsymbolic. The quotients combine to give the Full Scale Intelligence Quotient (FSIQ), which is an index of overall intellectual ability. Each of the subtests yields a scaled score with a mean of 10 and a standard deviation of 3. In addition, the five quotient scores named above, yield standard scores with a mean of 100 and a standard deviation of 15. Factor analysis of the UNIT provides support for two factors- Reasoning and Memory- and for a strong g factor (Sattler, 2001).

Results

Descriptive statistics for the test means and standard deviations and t ratios by gender and grade level are provided in Table 1. Perhaps the most salient outcome is the lowered UNIT IQs, specifically on the Cube Design and Analogic Reasoning subtests, and the FSIQ. Also, the mean scores on all scales were below average. In order to determine if UNIT FSIQs and the WISC-III PIQs differed, a t-test for paired samples was conducted. However, no significant difference was observed. A further comparison by gender indicated no significant differences; however, a comparison by grade level revealed that hearing impaired students in the middle school grades had significantly higher scores on the UNIT FSIQs than on the WISC-III PIQs($t = 2.652$, $p = < .01$).

A correlation matrix generated to examine the relationships among scores on the WISC-III and the UNIT revealed significant relationships, indicating substantial conceptual overlap. One of the primary relationships --that between UNIT FSIQs and WISC-III PIQs --was .813 (r^2 =66%) indicating a substantial conceptual overlap between the two scales.

Discussion

The results of the study indicate that the mean UNIT FSIQs and the WISC-III PIQs were not significantly different. This outcome coupled with the substantial relationship between the full scale means of the two tests suggests that one could reasonably be substituted for the other. This outcome is tempered by the finding that there is a relatively substantial discrepancy between the WISC-III mean PIQs and the mean UNIT FSIQs of the middle school students. Further questions are raised as the distribution for these students is restricted suggesting a great deal of homogeneity (SD=9.7359). Apparently, the educational backgrounds and experiences of the middle school sample are not as consonant with either the UNIT or the WISC-III as are those of the primary sample. Students, ages 11 through 16, were categorized as Middle School grade level, and further research should be conducted to determine what factors may be contributing to this difference.

Some reasons why two tests intended to measure the same skill(s) differ in outcome include: floor and ceiling effects, item gradients, differences in levels of difficulty of items, development of norm tables based on age and raw scores, use of grade or age equivalents, level of reliability, and measurement error, the different ways a global skill is assessed, variability of content sampled between measures, use of dated norms and tests, representativeness of the norm sample, and language of administration (Krivitski, 2000).

This study supports the need for continued research using the UNIT with this population. These outcomes also suggest that the UNIT should be considered as an appropriate and functional assessment tool when working with the hearing impaired.

Although this study used a small sample, it lends support to the literature indicating that both the UNIT and the WISC-III Performance Scale assesses similar cognitive abilities and constructs. However, one caveat is that the assessments were conducted by the senior author who is skilled in sign language and familiar with cultural norms of the hearing impaired. Tests administered to the hearing impaired by relatively untrained examiners could substantially attenuate the validity of the assessment. Thus, it is essential that test batteries be administered in the individual's preferred mode of communication by skilled examiners in order to be considered culturally fair and appropriate.

Limitations and Future Research

This sample of hearing impaired students was relatively small due to the nature of participant solicitation by referral from the school, as well as the limited geographic area (one school campus) and length of time available for data collection. A second limitation relates to factors such as etiology of hearing loss, age of onset of deafness, educational experience, co-morbidity of disabilities, exposure to different forms of sign language, length of time enrolled at school, and family background. As Krivitski (2000) suggests, these factors preclude simple generalizations regarding the performance of hearing impaired children unless those variables are addressed and held constan

Table 1

Descriptive Statistics by Gender and Grade Level

UNIT Full Scale Means and Standard Deviations

	M	**SD**
FSIQ	87.44	12.639
SM	8.32	2.971
CD	9.06	2,175
SM	7.77	2.918
AR	7.61	2.108
MQ	88.19	15.476
RQ	90.39	10.333
SQ	87.68	13.129
NSQ	90.81	10.753

WISC-III Means and Standard Deviations

	M	**SD**
PIQ	84.28	15.432
PC	8.39	3.016
COD	8.45	3.731
PA	6.74	3.483
BD	7.48	2.839
OA	6.74	3.235
DS	4.20	3.347

Table 2

UNIT FSIQs and WISC-III PIQs by Gender and Grade

		UNIT FSIQs		WISC-III PIQs		
		M	**SD**	**M**	**SD**	t
Total Sample	N=32	87.4375	12.6387	84.2813	15.4319	
By Gender						
Male	N=17	88.0588	15.1016	85.0588	17.4050	
Female	N=15	86.7333	9.5951	83.4000	13.3994	.299
By Grade Level						
Primary	N=12	93.9167	14.6005	93.5000	16.9572	
Middle	N=20	83.5500	9.7359	78.7500	11.6704	2.65*

$p<.01$

Table 3
Person r Correlations among UNIT IQs and WISCIII-IQs

r	PIQ	PC	COD	PA	BD	OA	DS	FSIQ	SM	CD	SM	AR	MQ	BQ	SQ
PIQ		.75	.575*	.854*	.811*	.755*	.561*	.812*	.589*	.640*	.579*	.639*	.650*	.750*	.69
PC			.094	.500*	.689*	.624*	.519*	.386**	.271	.539*	.190	.299	.252	.469*	.31
COD				.491*	.230	.170	.211	.585*	.516*	.236	.451*	.527*	.535*	.458*	.59
PA					.650*	.497*	.600*	.812*	.640*	.436**	.680*	.677*	.739*	.637*	.75
BD						.588*	.327	.608*	.431**	.772*	.396**	.355	.446*	.645*	.44
OA							.376**	.537*	.304	.500*	.386**	.444*	.397**	.580*	.48
DS								.308	.086	-.036	.621	.134	.447**	.013	.17
FSIQ									.843*	.522*	.806*	.815*	.915*	.791*	.94
SM										.306	.635*	.537*	.901*	.407	.90
CD											.086	.562*	.211	.816*	.56
SM												.587*	.905*	.388**	.70
AR													.630*	.821*	.83
MQ														.479*	.89
BQ															.70
SQ															
NSQ															

p<.05
p<.01

p<.05 = .34**
p<.01 = .44*

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