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Review of Intellectual Assessment Measures for Children Who Are Deaf or Hard of Hearing

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Overview: Intellectual assessment of children who are deaf or hard of hearing presents unique challenges to the clinician charged with attempting to obtain an accurate representation of the child's skills. Selection of appropriate intellectual assessment instruments requires a working knowledge of the strengths and weaknesses of the measure and what changes in standardized administration might be necessary to accommodate for the needs of children who are deaf or hard of hearing. In the case of some available instruments, there is limited guidance and objective research available examining the performance of children who are deaf or hard of hearing. This review summarizes available information on widely used and most recent editions of intellectual assessment measures with special attention to guidance on accommodations, score interpretation, subtest selection and other test-specific considerations when assessing children who are deaf or hard of hearing. **Summary:** There is much opportunity for further inquiry in the field of intellectual assessment as it applies to children who are deaf or hard of hearing, as many measures have not been closely scrutinized for their appropriate use with this population. Clinicians must recognize inherent difficulties with intellectual assessment measures with children who are deaf or hard of hearing and issues in providing for an accessible and accurate administration of test items.

Keywords: hearing loss, cognitive assessment, deaf, intelligence measures

Impact and Implications

- Although reviews of intellectual assessment measures available for use with children who are deaf or hard of hearing have been conducted in the past, a review of measures currently available and in circulation for use has not been conducted. The present review provides an overview of these measures based on criterion important in the clinical evaluation of a child who is deaf or hard of hearing.
- This review confirms that issues related to the communication skills of the child, clinician, specific variables related to the child's hearing loss and the goals of the evaluation all require consideration in selection of an instrument for use in a particular evaluation situation.

This review also confirms that in many cases there is a lack of information and evidence to appropriately answer important questions related to issues of possible test bias and other issues germane to test validity.

- Attention to issues of appropriately describing clinical samples and assessing instruments empirically for possible bias is a necessary component of future research to guide the appropriate use of intellectual assessment instruments with children who are deaf or hard of hearing.

Introduction

Intellectual testing of individuals with hearing loss (hereafter referred to as *deaf or hard of hearing*) is not a new topic in the field of psychological assessment. Numerous early nonverbal measures of intelligence (e.g., Binet & Simon, 1908; Pinter & Patterson, 1916) were developed with the intention of providing a measure to use for individuals who are deaf or hard of hearing (Marschark, 2006).

Reviews regarding tests that help a psychologist to assess the intellectual abilities of a child who is deaf or hard of hearing adequately are found in the literature from time to time with the most recent ones being published some 12 to 22 years ago (Bradley-Johnson & Evans, 1991; Simeonsson, Wax, & White, 2001; Spragins, 1998). Many chapters, though, have been written outlining general considerations for the intellectual assessment of

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children who are deaf or hard of hearing (e.g., Kammerer, Szarkowski, & Isquith, 2010). Further, since that time, many tests have undergone revision and updates, and new tests have been published. The field of intellectual assessment has continued to undergo change in that timeframe as well, with many measures decreasing overall reliance on verbal communication for instructions and responses and decreasing or shifting emphasis on the importance of speeded motor responses. Thus, it is appropriate to reexamine the set of currently used and available tools, which exist for conducting these assessments, and this reexamination is the premise for our review of instruments.

When conducting assessments that include general intellectual functioning, psychologists seek to use instruments that are psychometrically sound with respect to normative sampling, reliability, and validity and that are appropriate for use in the assessment of a particular child. For children who are deaf or hard of hearing, it is often difficult to find instruments that meet all of these criteria.

Assessment of Language Versus Language-Based Reasoning

Assessment planning and instrument selection for language-based reasoning can present a Pandora's box of both theoretical and practical challenges. Accurate assessment of language-based skills in American Sign Language (ASL) has been addressed elsewhere (see Prezbindowski & Lederberg, 2003, for a discussion of assessment in young children). These studies and tools, however, do not specifically address the use of ASL for reasoning and problem solving but focus on assessment of use or acquisition of ASL itself. The assessment of a child who is deaf or hard of hearing presents the clinician with a dilemma. How should the psychologist go about assessing language-based reasoning skills, particularly if the child is not a spoken English user and uses ASL, or if the child is a spoken language user who is struggling in their acquisition of spoken language skills? Assessment of the language skills of the child who is deaf or hard of hearing must be differentiated from language-based reasoning skills. There is considerably less guidance and support for how a clinician can go about doing the latter responsibly and ethically, though the former is certainly deserving of attention in its own right. Assessment of language-based reasoning skills with children who rely primarily on spoken language or are cochlear implant users is still challenging. The clinician must resolve the challenges related to how one goes about assessing these reasoning skills when the child's spoken language skills lag significantly behind hearing peers or are entangled with additional input factors. For example, what measures would be appropriate when a child presents with challenges to efficient spoken-language development (such as incomplete insertion of cochlear implant electrodes in a child with congenital malformation of the cochlea) but possesses no other viable means of communication? In that situation, is the child assumed to have no language-based reasoning skills? One might think so from reading the reports of clinicians that sidestep this important domain, citing that language-based reasoning measures would unfairly or inaccurately assess the child. Yet, sidestepping the issue and avoiding assessment of these skills does not mean that they cease to exist in the child who is deaf or hard of hearing. Rather, the field has not yet come to a point where clinicians are able to do so accurately and validly on a systematic basis.

Note in the review below that many tests of general cognitive skills and abilities specifically discourage psychologists from using their test in assessment of language-based reasoning skills of the child who is deaf or hard of hearing. Efforts undertaken by researchers in the field of deafness in the past few years have attempted to add to the repertoire of measures available for the practicing psychologist.

The Psychometric Toolkit Project from the National Science Foundation's Visual Language and Visual Learning center (www.vl2.gallaudet.edu) is an example of efforts to add to the known literature on a selection of cognitive and achievement measures. A series of measures were given to a group of well-described deaf and hard-of-hearing adults and then examined for test reliability and impact of test accommodation. This assessment toolkit, however, was developed for adults and piloted on college students (see Morere & Allen, 2012, for a complete discussion of the toolkit project). Related tools for assessment of children remain in pilot or research-development phases of production at the writing of this article.

Assessment of Nonverbal Reasoning

Assessment of nonverbal skills and abilities also requires the psychologist to attend to that many tests that use the term *nonverbal* in their title or description in fact mean different things. Take, for example, a test of reasoning abilities that is administered through pantomime and requires no verbal responses from the examinee. It is entirely possible that the examinee is relying on language-based mediation or reasoning strategies to respond to the test. In a different vein, tasks of mental rotation or spatial judgment are viewed as more "nonverbal" skills: These measures may be administered with verbal instructions, though the information being obtained is presupposed to tap into an examinee's spatial or nonverbal reasoning skills. Other work has reviewed critical issues in nonverbal measures of intelligence and critiqued many of the commonly used nonverbal assessment measures (see Braden & Athanasiou, 2005) regarding reliability, lack of evidence regarding response processes, test fairness, and critical issues of assessment planning for the practitioner to consider in selecting a nonverbal assessment measure.

Practical Considerations

Translation

Standard intelligence tests are generally lacking in sign language translations (Marschark, 2006) or standard procedures of administration for individuals whose primary language is not spoken English. Although some studies have used sign language translations, the translations have often not been validated through back translation or research comparing the translation to other means of assessment. Even when items are translated appropriately, it remains unclear whether the test item continues to demonstrate the same utility in American Sign Language (ASL) as it did when it was created in English. The *Standards for Educational and Psychological Testing* (American Psychological Association, 1999) directs psychologists to consider the needs of the individual test taker when adopting accommodations and to document the reason for such accommodations.

Primary Mode of Communication

Consideration as to how the child communicates is essential to selecting and interpreting results of intellectual assessment measures. Results regarding performance of deaf or hard-of-hearing children who use sign language or spoken language methods are often conflicting (Marschark & Hauser, 2008). This uncertainty must be considered when determining whether the child's performance is typical of his or her peers. For children who may use multiple languages, the *Standards for Educational and Psychological Testing* (1999) direct psychologists to determine which is the child's most fluent language and evaluate the child using that language to obtain the most representative assessment. Particularly for children using a signed language, consideration of their language fluency must be taken into account when deciding how to administer assessment measures. For psychologists who are not fluent in the children's preferred language or mode of communication, this assessment of fluency will require consultation with other professionals who can assess the children in their preferred language or mode of communication.

Use of Interpreters

A certified interpreter should be used whenever the examining psychologist cannot administer the assessment in the communication mode of the client (American Educational Research Association, 1999; Vernon & Miller, 2001). When working with interpreters, psychologists continue to retain ultimate responsibility for interpretation of test results. In the situation where psychologists have limited or insufficient fluency in the language used by the interpreter, psychologists must devise other ways to limit threats to the validity of their assessment as much as possible. During the interpretation process, questions may arise about whether or not stimuli can be altered, and if alterations are made, then whether or not the intended skill is being assessed at the intended developmental level. The use of interpreters requires the examiner to be cognizant of the inherent problems associated with using an interpreter in psychological and medical settings and in particular requires that the interpreter have experience in mental health interpreting and in working with children (Hill-Briggs, Dial, Morere, & Joyce, 2007). Previous research on using either a sign language interpreter versus an ASL-fluent clinician administering the Wechsler Intelligence Scale for Children—Revised (WISC-R) demonstrated no significant differences in scores obtained in a large sample of children who are deaf or hard of hearing (Sullivan & Schulte, 1992).

Unfortunately, for the practicing psychologist, there are vast differences in the quality of individual interpreters (even when "certified"). This is in part because of the limited obligation for interpreter training programs to require supervised on the job or practicum training in a variety of settings (Dean & Pollard, 2001). As Dean and Pollard (2001) aptly pointed out, sign language interpreters rate their own training as lacking in preparation for practice in the challenging settings in which they often find themselves (mental health interpreting included). The mental health clinician is also responsible to be aware that the ethical code of sign language interpreters prohibits interpreters from providing counsel or interjection of personal opinions (National Association of the Deaf and Registry of Interpreters of the Deaf, 2005).

Presence of Additional Disabilities

Concern about additional disabilities is particularly important because deafness often occurs in the context of other developmental problems (Marschark & Hauser, 2008; Vernon, 2005). Recent nationwide demographic surveys of deaf and hard-of-hearing students receiving special education services indicates that approximately half have additional disabilities (Gallaudet Research Institute, 2007; Mitchell, 2006; Szymanski, Brice, Lam, & Hotto, 2012). Hearing loss that occurs because of genetic nonsyndromic hearing loss (i.e., a deaf child of deaf parents) may represent decreased risk for additional neurological concerns or syndromes (Marschark, 2006) when compared with children with hearing loss from other etiologies. Additionally, when assessing a deaf child it is important to consider the age that the child's hearing loss was identified. Delay in time for diagnosing a hearing loss in a child will subsequently delay language and communication intervention, or access to amplification, which in turn impacts the child's academic and social success. Although the legislation and implementation of newborn hearing screenings has dramatically lowered the age of diagnosis of hearing loss, there remain many cases in which hearing loss may go undetected for long periods (i.e., progressive hearing loss, hearing loss secondary to ototoxic medications, and noise-induced hearing loss).

Normative Concerns

Finding and using an appropriate normative group for test-score comparison and for generation of standardized scores is an inherent part of the test development and standardization process. Particularly for measures meant and developed for broad use and applicability (such as intellectual assessment measures), the typical normative sample will be broadly representative of the U.S. population in terms of many demographic characteristics. For those whose practice consists of individuals that present challenges in terms of comparison against a normative sample (i.e., English language learners, children who are deaf or hard of hearing, or individuals with additional disabilities), the psychologists are placed in a difficult position. They must decide whether comparison against the normative sample provided by the test publisher is sufficient for ethical practice and assessment or whether additional scrutiny such as comparison against a clinical sample is needed.

Within the field of deafness, there are arguments both for and against the use of so-called "deaf norms." In cases where individuals present with congenital hearing loss and have been exposed to a visually accessible language since childhood, deaf norms may not be necessary, particularly when the assessment concerns nonverbal or nonlanguage-based questions. In the case of children who are deaf or hard of hearing and are spoken language communicators vis-à-vis cochlear implants or hearing aids, they may represent the hearing normative sample more closely in terms of educational and language-based experiences, thus rendering comparison with the typical normative or standardization sample appropriate. In comparison, when discussing assessment of language-based reasoning skills and the child to be assessed uses a language different from that in which the test was developed (i.e., ASL vs. spoken English), a separate normative set may be desirable and necessary. The task demands change, and the likelihood for differential item functioning would presumably increase.

Similarly, the argument for use of a deaf normative sample increases when one considers that the heterogeneous group of neurological conditions often associated with hearing loss is also associated with increased risk for neurocognitive compromise (e.g., meningitis, prematurity, cytomegalovirus infection, or syndromic forms of hearing loss such as Kabuki syndrome). Consideration of these risk factors compounds the likelihood of finding that there are more differences than similarities in terms of developmental experience, educational and language experience between these children and the normative sample. That being said, the vast amount of heterogeneity within a sample of individuals with hearing loss or deafness creates logistic difficulty for a test developer to even consider development of a deaf normative group. Who should this sample consist of? Individuals with only syndromic forms of hearing loss? Individuals who present with an accessible language from birth? How far must the hairs be split to develop a robust and meaningful comparison group without being overly restrictive? These remain challenges to the field as well as to the practicing clinician.

Empirically, many of the analyses required to determine the presence or absence of bias in intellectual assessment measures has not been done and applied to measures commonly used with children who are deaf or hard of hearing. Jensen (1980) outlined many of the empirical assessments required to detect the presence of bias in a measure, written at a time when differences between racial or ethnic groups was a heated topic of discussion. Similarly, the analyses and methodology proposed by Jensen remain salient to objectively verify whether or not specific measures display differential item functioning with a group of examinees that may not represent the normative sample. This analysis and objective review of performance is particularly needed for children who are deaf or hard of hearing, as questions of accessibility, bias, and relative performance remain salient when assessing this group with contemporary intellectual measures.

Within this review, we do not attempt to portray or imply that small differences between groups of children who are deaf or hard of hearing and the normative sample represent *de facto* evidence of test bias or inappropriateness. Instead, we present practicing psychologists with the information about each of the measures reviewed for them to make informed decisions about selection of an appropriate instrument for the assessment of a child who is deaf or hard of hearing.

Review of Instruments

Instruments were selected for review based on multiple systematic searches of various databases that index studies relevant to cognitive assessment and deaf or hard-of-hearing children. Specifically, PubMed and PsycINFO were used for the present search. The terms *cognitive assessment*, *deaf*, *hard of hearing*, *hearing loss*, and *hearing impaired* were all used to produce an initial listing of citations, yielding a total list of 419 citations for review. Those abstracts were then reviewed, and only those studies that included actual reports of performance of children who were deaf or hard of hearing on the measure of interest were included in this review. In many cases, studies cited mentioned deafness, hearing loss, or other disabilities in a discussion or other part of the abstract that made their study appear in the initial search but did not actually reference any performance-based data; these data were

excluded after initial review. Tests and measures that were produced exclusively for use with adults or tests of language or other domains were excluded, as were tests that lacked any research or reference to use with children who are deaf or hard of hearing, resulting in a total of 13 tests to be reviewed. Tests that have not been updated in the past 20 years (e.g., Hiskey-Nebraska) were not included and only current versions of tests available at the time of this article writing were reviewed. Subsequent searches were performed with the specific test name and abbreviation, and the terms *deaf*, *hearing loss*, *hearing impaired*, and *hard of hearing* were used to produce the literature to be reviewed in this assessment, along with a review of the test manuals, technical manuals, technical bulletins, and any information available from the publisher regarding the performance or use of the specific measure with children who are deaf or hard of hearing. The most current version of each measure was included in review with the exception of the Leiter International Performance Scale (Leiter), in which both the Leiter-R and the Leiter-3 were included, given that the Leiter-3 had only recently become commercially available.

The purpose of this review is to provide a concise yet thorough analysis of different measures of intellectual functioning and their applicability to children who are deaf or hard of hearing. All measures were reviewed in accordance with five criteria relevant to the assessment of children who are deaf or hard of hearing. The five criteria selected in this review represent issues of clinical importance. Their importance to a psychologist evaluating a measure would be expected to change based on the referral question the psychologist is addressing, the background characteristics of the child, and the language–communication skills of the psychologist.

Criterion 1: Administration and accommodations guidance.

Tests were evaluated based on whether there was guidance on administration and accommodations specific to children who are deaf or hard of hearing. In many cases, this information was found in the test manual or in technical supplements.

Criterion 2: Score interpretation guidance. Tests were evaluated based on the data and information provided to assist the clinician in deciding whether or not obtained scores for children who are deaf or hard of hearing may be interpreted and compared to which normative or clinical sample.

Criterion 3: Described group of children who are deaf or hard of hearing. The description of the group and not the presence or absence of the group was chosen as a criterion. During the review process our group found a varying array of descriptions provided, with some tests giving detailed information that would be relevant to a clinician, and others providing little or no information regarding key background variables regarding the group of children who are deaf or hard of hearing.

Criterion 4: Empirical reports of children who are deaf or hard of hearing. This criterion served as an indicator regarding the use of the particular measure for evaluating various groups of children who are deaf or hard of hearing for research purposes and questions.

Criterion 5: Empirical assessment of possible bias. We examined each of the measures for information presented in the test manuals, technical bulletins, or in empirical literature found in the review process regarding empirical assessment of possible bias.

These same criteria were applied across measures to allow the reader to compare various measures for their own clinical purposes when selecting an appropriate assessment instrument for the assessment of a child who is deaf or hard of hearing. Each of the tests was rated along each criterion described above and presented in Table 1.

The tests were rated as “no” if the test did not supply information or no information was available from the literature search in this criterion. Tests were rated as “yes” if information regarding the specific criterion were presented in the materials reviewed. Tests were given a yes with^a (Yes^a) designation if a test or literature available on a specific measure goes into more depth or has multiple studies supporting the criterion.

Administration Accommodations Guidance

As a whole, the measures reviewed provided a wealth of guidance on administration accommodations and appropriateness of administration of specific subtests through different modalities of communication. For 9 of the 13 measures reviewed, this was an area of strength. For some of the measures, this was an inherent and large point of discussion in the test manuals because the instructions included instruction for administration through sign language, gesture, pantomime, or other nonverbal means (e.g., Leiter R-3, Differential Ability Scales-Second Edition [DAS-II], Wechsler Nonverbal Scale of Ability [WNV], Comprehensive Test of Nonverbal Intelligence-Second Edition [CTONI-2], and Universal Nonverbal Intelligence Test [UNIT]). Of these, the DAS-II stood out as a measure where specific information was provided in

the translation of subtest administration instructions to ASL and blind backtranslated to ensure fidelity to the instructions. Although this process itself has been recommended by many in the field as the standard for ensuring accurate translation of instructions, this was the only test kit that made an ASL translation of the instructions available on DVD. In some cases, information regarding accommodations appears to have been an oversight, as the manuals otherwise describe administration of the test on groups of children who are deaf or hard of hearing yet leave out information regarding specific strategies for accommodations (e.g., RIAS). In the situation of the WISC-IV, although the manual specifically describes work on administration of a measure to large groups of children using ASL, there is not yet a publicly available translation of the WISC-IV into ASL (Braden, 2005), though previous work on the WISC-III demonstrated the usefulness of this endeavor. The WNV also describes the process of translation and backtranslation and refers to a DVD made for training purposes, though this has not become widely available for the practicing psychologist.

Score Interpretation Guidance

Almost half of the tests reviewed provide little explicit reference regarding whether or not scores obtained on assessment measures with children who are deaf or hard-of-hearing can be reliably compared to the normative sample. Notable exceptions are measures that included expert review panels and devoted space in their test manuals to discussions of this issue (e.g., DAS-II, Kaufman Assessment Battery for Children, Second Edition, WNV, WISC-IV and UNIT). Despite the more extensive discussion, time, and energy devoted to how one goes about administering a measure to a child who is deaf or hard of hearing, psychologists are left with considerably less data presented overall to guide how (and whether or not) to interpret the scores obtained as a whole.

Table 1
Test Review Scorecard for Children Who Are Deaf or Hard-of-Hearing

Test	Administration-accommodation guidance	Score interpretation guidance	Described group of D/HH in manual	Empirical reports of D/HH in literature	Empirical assessment of possible bias
Bayley-III	Yes	No	No	No	No
SB5	Yes ^a	No	No	No	No
Leiter-R	Yes ^a	Yes	Yes ^a	Yes ^a	Yes
Leiter-3	Yes ^a	Yes	Yes ^a	No	Yes
WJ-III COG	Yes ^a	No	No	No	No
WPPSI-IV	No	No	No	No	No
DAS-II	Yes ^a	Yes ^a	Yes ^a	No	Yes ^a
KABC-II	Yes	Yes ^a	Yes ^a	No	Yes
RIAS	No	No	Yes	No	No
WNV	Yes ^a	Yes ^a	Yes	No	Yes
WISC-IV	Yes ^a	Yes ^a	No	Yes	No
CTONI-2	Yes ^a	No	No	Yes ^a	Yes
UNIT	Yes ^a	Yes ^a	Yes ^a	Yes ^a	Yes ^a

Note. Bayley-III = Bayley Scales of Infant and Toddler Development—Third Edition; SB5 = Stanford-Binet Intelligence Scales, Fifth Edition; Leiter-R = Leiter International Performance Scale—Revised; Leiter-3 = Leiter-Third Edition; WJ-III COG = Woodcock-Johnson, Third Edition, Tests of Cognitive Abilities; WPPSI-IV = Wechsler Preschool and Primary Scale of Intelligence—Fourth Edition; DAS-II = Differential Ability Scales—Second Edition; KABC-II = Kaufman Assessment Battery for Children, Second Edition; RIAS = Reynolds Intellectual Assessment Scales; WNV = Wechsler Nonverbal Scale of Ability; WISC-IV = Wechsler Intelligence Scale for Children—Fourth Edition; CTONI-2 = Comprehensive Test of Nonverbal Intelligence; UNIT = Universal Nonverbal Intelligence Test; D/HH = deaf or hard of hearing.

^a multiple studies.

Described Group of Children Who Are Deaf or Hard of Hearing

Level of detail and homogeneity of groups assessed are important details to psychologists designing an assessment for a child who is deaf or hard of hearing because of the multiple reasons discussed in the introduction. The tests reviewed varied a little. Some provided no information on children who are deaf or hard of hearing because this group was not included as part of any standardization or clinical sample (e.g., Bayley Scales of Infant and Toddler Development—Third Edition, Woodcock-Johnson, Third Edition, Tests of Cognitive Abilities, Wechsler Preschool and Primary Scale of Intelligence—Fourth Edition). In other cases, only scant information was provided regarding key variables such as pure tone average of hearing loss, communication modality, and use of assistive listening devices. This is an area where test developers could easily collect and provide information regarding their clinical sample that would provide much more useful information to the practicing psychologist. Average scores on specific subtests from a clinical sample of 30 to 50 children who are deaf or hard of hearing are difficult to interpret without additional information that allows the user to place that information into context, such as degree of hearing loss and communication modality used at a bare minimum. Given the high time and cost commitment required to recruit and obtain such large specialized samples, reporting sufficient information regarding key characteristics of those samples would do little to increase the overall cost but would do much to increase the usefulness of data obtained.

Empirical Reports in the Literature Reviewed

Despite the many book chapters and other publications reviewed regarding general principles of assessment for children who are deaf or hard of hearing, there is relatively little in the research literature by comparison. Of the literature reviewed where performance on intellectual measures by children who are deaf and hard of hearing were reported, tests that relied on nonverbal or pantomime instructions and did not require a verbal response appeared much more frequently (e.g., Leiter-R, CTONI-2, and UNIT). Particularly in the cochlear implant literature, the Leiter-R emerged frequently as an indicator of pre- or postsurgical nonverbal intellectual abilities and also frequently used to monitor progress over time.

Empirical Assessment for Possible Bias

The question whether a test may be biased or function differently in a group of individuals systematically is frequently raised when intellectual assessment measures are used as a criterion for admission to special services, determination of disability status, a requirement for gifted educational programming, or other such cut-off. Jensen (1980) explored the issue of bias in intellectual assessment, pushing the field toward a more empirical and psychometrically sound approach to the question of whether or not specific tests functioned in a biased way with specific groups. Unfortunately, as it relates to children who are deaf or hard of hearing, many of the statistical analyses proposed by Jensen have not been carried out with current intellectual assessment measures. Most questions of bias are left unanswered with this unique population.

Maller (2000) has done the most work on this topic, examining the UNIT for differential item functioning with children who are deaf or hard of hearing, making it a measure that has been more closely scrutinized. Maller's (2000) study of the UNIT indicated no items in the four subtests studied exhibited differential item functioning.

Discussion

Review of measures available and commonly used for purposes of cognitive assessment of children who are deaf or hard of hearing raises several important issues for consideration. When selecting a measure for use with a child who is deaf or hard-of-hearing, the individual clinician is presented with a challenging situation in that few of the tests reviewed included a well-described group of children with hearing loss in their standardization or clinical sample. This creates challenges for clinicians when deciding whether or not a particular test is appropriate for use in assessment. The purpose of this review was not to establish whether or not deaf "norms" are either necessary or superior in terms of evaluating a given instrument but rather to provide the necessary information in an overview format to help clinicians make those types of clinical decisions on a case-by-case basis given the presenting characteristics of their patient.

The use of accommodations for administration of test items also presents a challenge to clinicians, with few measures providing formal guidance on whether or not translation is acceptable and whether or not that changes the task demands of the items. Tests that provide standardized information on an ASL translation of instructions certainly assist clinicians to provide an accurate and true translation of task instructions, such as was done for the DAS-II. Tests that are presented entirely through gesture also display an advantage with this special population as the concerns regarding translation issues are minimized.

Tests included in the present review included those that assessed nonverbal reasoning as a stand-alone construct, as well as those measures that assessed language-based and nonverbal reasoning concurrently. Whether an intellectual assessment of a child who is deaf or hard of hearing should rely exclusively on a nonverbal reasoning measure, in large part, depends on the nature of the referral question, background of the child, goals of the evaluation, and language skills and fluency of the examiner. When and if a hearing psychologist with limited proficiency in ASL is assessing the cognitive skills of an ASL-using child who is deaf or hard of hearing, the inclusion of measures requiring interpretation and evaluation of a child's language may be viewed as wholly inappropriate.

Although administration following "nonstandard" administration of "verbal" items translated into ASL automatically makes one question the validity of the obtained results, clinicians responsibly attempting to provide evaluation services are left with few options. It has been argued by some (Akamatsu, Mayer & Hardy-Braz, 2008) that blind backtranslated ASL versions of intellectual assessment measures do not appropriately address the difficulty clinicians face in assessing the verbal cognitive abilities of children who are deaf or hard of hearing. These authors in particular have proposed assessment of the "types of thinking that they are able to do with language" (Akamatsu et al., 2008, p. 145) through assessment of a broader base of cognitive skills under more opti-

mal testing conditions, as well as increased research on how children who are deaf or hard of hearing perform on the specific domains being assessed. The present review of tests would support such a research direction given the assessment tool options available to the practicing clinician.

Future research is needed to explore the performance of varying groups of children who are deaf or hard of hearing on the various measures discussed in this review, with comparisons across measures and correlation with real-world functioning and skills. As many of the tests in this review have examined the performance of typically developing deaf or hard-of-hearing children, it is also imperative that smaller studies examine the performance of groups with frequently occurring clinical diagnoses, such as attention-deficit/hyperactivity disorder.

It is hoped that in the future technological solutions may also be available more readily for clinicians to promote accessibility of assessment measures through the use of video-enabled applications that may be able to present test stimuli in a standardized fashion, as well as video technology for capturing and analyzing signed language responses. This holds promise, especially for deaf and hard-of-hearing children in rural areas or remote communities where access to clinicians trained in various communication modalities may be limited. Test developers are encouraged to explore testing platforms that allow for use of video-assisted administration for deaf and hard-of-hearing users. Although technology cannot replace the need for clinical observations that supplement test results, it may be a useful tool for providing more accessible assessment instruments and ensuring that clinicians provide comprehensive assessment services when they are indicated.

Ultimately, this review confirms that clinicians undertaking cognitive assessment with children who are deaf or hard of hearing must take into account multiple issues when selecting measures to assess children who are deaf or hard of hearing. An inherent limitation of this (or any) review of the literature conducted that includes the most current form of an instrument recognizes that instruments more recently published and made available for use have had considerably less opportunity for scrutiny and use from the scientific community. Measures that are relatively newer may in time prove to be more useful in a later review when they have had the opportunity to undergo additional scrutiny. This review has also not included information available on previous editions of tests, though in some situations previous versions of tests had been studied more carefully for issues of importance in the assessment of children who are deaf or hard-of-hearing. Many of these previous studies of issues of bias and blind back-translation require replication with presently available measures.

There is no single test or battery that emerges as being superior for assessment of a child who is deaf or hard of hearing but rather a thoughtful analysis of factors related to the test, the normative sample, the task demands, the examiner's own linguistic competence, and the communication preference of the individual child must be considered when selecting an appropriate cognitive assessment measure.

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