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# Research in Developmental Disabilities



## Comparison of two nonverbal intelligence tests among children who are deaf or hard-of-hearing



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### ARTICLE INFO

#### Article history:

Received 6 September 2013

Received in revised form 15 November 2013

Accepted 18 November 2013

Available online 20 December 2013

#### Keywords:

Hearing loss

Deaf or hard-of-hearing

Nonverbal cognitive assessments

Intelligence tests

### ABSTRACT

The primary goal of the current study is to evaluate the concurrent validity of the Leiter International Performance Scale-Revised (Leiter-R Brief IQ) and Differential Ability Scales – Second Edition (DAS-II Nonverbal Reasoning Index) in a group of children who are deaf or hard-of-hearing. Knowing the breadth of cognitive tools appropriate for use in children who are deaf or hard-of-hearing is highly beneficial, given that clinical and school psychologists are often challenged to reliably assess cognitive functions in the context of hearing loss. Participants included 54 children between three and six years of age with permanent bilateral hearing loss. As part of the study, neurocognitive assessments were conducted by a pediatric neuropsychologist or licensed clinical psychologist with extensive experience administering assessments to children with developmental disabilities, including children with hearing loss. The Leiter-R Brief IQ score was similar to the DAS-II nonverbal reasoning index, with no significant difference in the mean scores across the two assessments. The severity of hearing loss was not correlated to either the Leiter-R or the DAS-II nonverbal IQ. Nearly a quarter of the children evaluated had meaningful intra-individual differences between scores on the Leiter-R and DAS-II that were more than one standard deviation from one another. Conducting accurate intellectual assessments in children who are deaf and hard-of-hearing is fundamental in determining and designing interventions and educational services. More comprehensive neuropsychological test batteries utilizing several tasks to assess a single domain (such as nonverbal reasoning) may be warranted for children who are deaf or hard-of-hearing.

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## 1. Introduction

Nonverbal intelligence has been shown to be a significant predictor of language functioning among deaf and hard-of-hearing children (Dawson, Busby, McKay, & Clark, 2002; Geers, Moog, Biedenstein, Brenner, & Hayes, 2009; Geers, 2003; Khan, Edwards, & Langdon, 2005; Meinzen-Derr, Wiley, Grether, & Choo, 2010; Moeller, 2000; Pisoni & Geers, 2000; Surowiecki et al., 2002). Because isolated hearing loss per se is not associated with lower performance on tests of nonverbal cognitive abilities, children who are deaf and hard-of-hearing demonstrate similar cognitive performance as their hearing peers (Khan et al., 2005; Krivitski, McIntosh, & Finch, 2004; Mayberry, 2002; Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998;

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Zekveld, Deijen, Goverts, & Kramer, 2007; Zwiebel, 1987). Nonverbal intelligence tests also appropriately remove language barriers in the estimation of cognitive functioning for children with hearing loss (Zekveld et al., 2007). In addition, it has been suggested that children with greater hearing loss utilize more efficient strategies during spatial working memory tasks, possibly to compensate for the loss of speech information (Zekveld et al., 2007).

A challenge associated with evaluating intellectual functioning in children with varying levels of hearing loss is determining which measures minimize the impact of not only auditory deficits, but related language deficits in hard-of-hearing children. Intellectual tests commonly used in typically developing populations, such as the Wechsler Intelligence Scale for Children series (i.e., WISC, WISC-II, WISC-III, and WISC-IV) (Wechsler, 1949, 1974, 1991, 2003), Kaufman Brief Intelligence Test (i.e., KBIT & KBIT-2) (Kaufman & Kaufman, 2004), Stanford Binet Intelligence Scales (SB-I,II,III, IV, & V) (Roid, 2003), and the Differential Ability Scales (DAS & DAS-II) (Elliott, 1990a, 2007) may be less ideal in children with hearing loss due to the high expressive and receptive language processing demands inherent to these tests. Additionally, the vast majority of cognitive assessment tools involve oral administration of directions per standardization requirements. Orally-administered assessments may therefore underestimate cognitive abilities in those with hearing loss (Braden, 1992b; Maller & Braden, 2011; van Boxtel et al., 2000; Zekveld et al., 2007). Thus, measures focusing on visual reasoning, visual discrimination, and abstract visual problem-solving may be more appropriate in assessing cognition in this population.

### 1.1. *Leiter International Performance Scale – Revised*

The Leiter International Performance Scale – Revised (Leiter-R) (Roid & Miller, 1997) is a nonverbal intelligence assessment that has been characterized as the “gold standard” assessment tool for children with hearing loss by many practitioners (Braden, 1992b). The Leiter-R addresses a wide range of cognitive functions similar to those found on more traditional measures, including (but not limited to) visual scanning/discrimination, visual synthesis, and visual abstract reasoning. A distinctive characteristic of the Leiter-R is the preferential use of nonverbal and pantomime instructions, which eliminates the need for verbal instructions throughout the test’s administration. This feature significantly contributes to the test’s validity as an impartial measure of nonverbal cognitive assessment in groups of children with varying levels of hearing loss because it eliminates the negative influence of auditory and language delays/deficits on test performance. Despite the obvious advantages of using the Leiter, Braden (1992b) found that practitioners in educational and clinical settings tended to prefer the Wechsler series over the original Leiter. His review of the literature looking at 286 studies of assessment practices used with deaf and hard-of-hearing individuals found that only a small proportion of practitioners and researchers included the Leiter ( $n = 12$ ) in their battery and exhibited a strong preference for the Wechsler series ( $n = 102$ ). The reasoning behind the choices between the assessments was not reported. It is possible that the preference for the Wechsler Scales may have been due to increased exposure to the assessment batteries during the practitioners’ training and/or the financial constraints.

### 1.2. *Differential Ability Scales – Second Edition*

The Differential Ability Scales – Second Edition (DAS-II) (Elliott, 2007) is also a standardized measure used to assess cognition that has been increasingly used with children with autism spectrum disorders (Bishop, Guthrie, Coffing, & Lord, 2011). It is also frequently used in schools to measure children’s cognitive abilities and to assist with school planning. A benefit of using the DAS-II in preschoolers or children with suspected delays (particularly language) is a very low item floor and expanded ceiling, which allows for adaptive testing in children who possess very low or very high ability level. Moreover, the DAS and DAS-II have been used to identify learning disabilities through identification of processing style and the provision of an ability-achievement discrepancy analysis, both of which allow for more specific intervention planning (Braden, 1992a). Regardless of the popularity of the DAS and DAS-II as cognitive tests for children with learning disabilities or autism, its use has not been independently validated in populations of children with hearing loss.

Nonverbal performance scales are not necessarily comparable, despite measuring similar constructs. However, a moderate correlation ( $r = 0.67$ ,  $p < 0.01$ ) has been noted between the Test of Nonverbal Intelligence – Second Edition (TONI-2) and WISC-III Performance IQ in a group of school-aged children with varying levels of hearing loss (Mackinson, Leigh, Blennerhassett, & Anthony, 1997). With regard to the Leiter-R, criterion and construct-related validity data was presented by Roid and Miller (1997) in a group of gifted children and children with cognitive delay in which a Pearson correlation of 0.86 was found between the Leiter-R IQ and WISC-III Full Scale IQ ( $N = 121$ ,  $p < 0.001$ ).

### 1.3. *Research objective*

Clinical and school psychologists are often challenged to reliably assess cognitive functions in the context of hearing loss. Knowing the breadth of tools appropriate for use in this population is therefore highly beneficial. As such, the primary goal of the current study is to evaluate the concurrent validity of the Leiter-R Brief IQ and DAS-II Nonverbal Reasoning Index in a group of children who are deaf or hard-of-hearing. Because intelligence measures are often used by clinicians to predict language development among children who are deaf or hard-of-hearing, the relationship between language and the different assessments was also investigated.

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